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THE HABITS OF SOME ARVICOLINÆ.[1]

BY EDGAR R. QUICK AND A. W. BUTLER.

FOUR species of Arvicolinæ have been found in Southeastern Indiana, and it is to certain observations of the habits of these that your attention is called. The species referred to are *Synaptomys cooperi* Bd., *Arvicola pinetorum* LeC., *Arvicola riparius* LeC., and *Arvicola austerus* Ord. The latter is the rarest species, and *A. riparius* is by far the most common.

The credit of the discovery of Cooper's field mouse in Indiana belongs to that pioneer of Western naturalists, Dr. Rufus Haymond, who, in 1866, sent an alcoholic specimen of this mouse from Brookville to the Smithsonian Institution. Dr. Haymond says of this specimen : " I think it was in June, 1866, that I discovered this mouse about a mile north of Brookville. I thought it a common meadow mouse (*A. riparius*) ; when caught I put it into an old leather purse in which I had previously confined a small shrew. When I reached home I found the shrew had killed the mouse ; the little murderer soon fell a victim to the law of blood revenge, and was packed with its victim in a jar and sent to the Smithsonian Institution." This mouse is numbered 9963 in the Smithsonian collection.

No other specimen was taken in Indiana for several years. In 1879 one of the writers took the second specimen found in this State, about three miles below Brookville and four miles from where the first one was taken thirteen years before. Specimen after specimen followed this one, all being taken from the same locality.

From the most reliable information obtainable, we conclude

[1] Read before the section of biology A. A. A. S. at Philadelphia, Sept., 1884.

that less than fifty specimens of this little mammal have ever been taken, of which number more than half have been secured by the writers from this same locality.

This mouse is found on hillsides in high, dry, blue grass pastures, where flat stones are irregularly scattered over the surface; it especially prefers what are known as "woods pastures," containing little or no undergrowth.

The locality whence Dr. Haymond obtained his specimen is a hillside pasture field, with no trees, sloping towards the east. The greater part of the other specimens have been taken from a steep rocky hill sparsely covered with timber, known as "Brown's hill."

Cooper's field mouse has been found breeding from February to December. It has never been known, by the authors, to bring forth more than four young at a time. In all suckling females which have been brought to our attention the mammæ have apparently been but four, one pair pectoral and one pair inguinal. Dr. Coues says (Monographs of N. A. Rodentia): "In No. 9963 (Dr. Haymond's specimen) apparently a nursing female, we find two pairs of pectoral mammæ and one pair of inguinal mammæ, without being able to make out any intervening ventral ones. It is probable, however, that the species possesses a ventral pair, making eight teats in all."

In this matter, from the light we now have upon the subject, we are not able to coincide with Dr. Coues in his views.

In young specimens the hair appears finer, shorter and more glossy than in more aged examples. As a rule the specimens just reaching maturity are darkest, but one old female shows a very dark reddish-brown back, and is dark ash below. If there is any difference in sexual coloration, the females are slightly the darker.

The nest of this species is always under cover, generally in a hollow log or stump, and is composed of fine grass. It is not so securely built as the nests of some of the other species of this family.

Cooper's mice live in winter chiefly upon the stems of blue grass and the more tender portions of the white clover. Stores of these foods may be found near their winter quarters. In November, 1883, a large quantity of the tuberous roots of the plant commonly called "wild artichoke" (*Helianthus doronicoides* Lam.)

were found in one of the store-houses of a colony of these mice.

These mice vary much in numbers in favorable localities in different years, but it is questionable whether this variation is from migration or irregular causes. In 1879 they were very common on Brown's hill, many of them frequenting the remains of an old stone mound. No other species were commonly met with in this locality at the same time. This year no examples of *S. cooperi* have been taken on the top of this hill, but a single specimen was found at the base of the hill. Since Dr. Haymond took his specimen north of Brookville no other example has been found in this direction from town, although sought for at different times.

Cooper's mouse is the most active representative of its family in this locality. It is most frequently found by turning over stones and logs, beneath which it remains concealed, especially in winter. Upon removing their covering, as the light reaches them, they are off like a flash for their subterranean paths, leaving the collector to mourn for a valuable specimen, a glimpse of which he caught as it fled before his hand could grasp the prize.

Another interesting representative of this family is the pine mouse (*Arvicola pinetorum* LeC.). This species has generally been considered rare in this locality, but in a two hours' hunt last February eleven specimens were taken by the writers. Several specimens have also been captured by a cat within a little more than a year.

Dr. Coues aptly says in his Latin description, "forma quasi-talpoidea;" the species strongly resembles the mole in form, especially in the size of its fore feet and in the strength of the forward part of its body, and also in its habits.

The runways of the pine mouse are nearly always under ground, sometimes an inch or more beneath the earth, the line of which may easily be traced by the upheaved earth.

The locality where the pine mice, to which reference has just been made, were taken, has long been a favorite place for the mice-catchers of the local society of natural history to find *Synaptomys cooperi.* On this particular occasion but a single specimen of this interesting species was taken, while almost a dozen examples of a species which had previously been regarded as rare were found in its accustomed haunts.

These examples were taken from the higher part of a steep, partially wooded hill. They apparently sought the west and south-west sides, where they were found beneath leaves, logs, stumps and stones. Upon the covering being suddenly removed they appear dazed, affording for an instant an opportunity to capture them; should the first attempt prove futile, they seek safety in the first available hiding place, but when frightened from here, hasten through their labyrinthic underground passages and are seldom seen again.

Of their breeding habits we have noted nothing. As a rule the pine mice winter in a last summer's nest, which is a round ball of blue grass blades, from four to six inches in diameter; the interior is composed of fine grass which is nicely bound together with longer blades. The nest is generally placed beneath a pile of leaves or an old stump. In winter collecting single specimens are generally observed occupying these old nests.

The pine mouse, in winter, lives upon the tender roots of young hickories, the young sprouts of the white clover (*Trifolium repens*), the fruit of the red haw (*Cratægus coccinea* L.) and the tuberous roots of the wild violet (*Viola cucullata* Ait.). The first of these he uses for luncheon while excavating his runways. It is never found stored in his burrows, but as his passages approach these roots they expand, laying bare a large portion of the root from which the bark is generally entirely removed. The other products we find buried, the latter in numerous deposits, some of which contain a gallon of tubers and extend eighteen inches below the surface of the ground. This latter article evidently forms the bulk of their winter food.

The common meadow mouse (*A. riparius*) is the most common mammal in Southeastern Indiana. It varies in numbers with the seasons. Some years the fence rows of wheat and barley fields are traversed by a network of their runways. In autumn, after the frost has cut down the more tender parts of the weeds and grass, numbers of these little rodents may be seen darting here and there through their half-covered passages. In winter they are warm friends of the farmer who leaves his corn in the shock latest. After the early snows have fallen the corn shocks will be found thickly colonized by these little pests, who find here not only a comfortable residence, but also a well-filled granary from which to draw their winter's food. In spring, when the last snows

have disappeared, one will observe where the meadow mice have advanced their passages very near the public thoroughfare, while the neighboring pastures and commons show many traces of their highways. Their food in winter is the corn found in the thriftless farmer's shocks, together with the seeds of a number of plants and the young blades of the blue grass. Their large round nests are also constructed of the blades of this and kindred grasses. They are built much after the manner of musk-rat houses, a miniature of which they closely resemble.

The single opening is below, where it connects with the runways of the animal. These nests are found in almost every conceivable place : in thickets and brier patches among the rank grass which grows there, in swampy places upon a tussock of grass, in a log or fence corner, under a pile of rubbish and very many on the open ground, especially in clover meadows, where the mice may prey upon the nests of the humble-bee.

The meadow mice breed from February to December. A succession of favorable or unfavorable circumstances, as the case may be, causes either an abundance or scarcity of specimens.

This mouse has an ingenious and patient method of securing the head from a standing stalk of grain. Selecting a stalk which gives promise of a large well filled head, the mouse cuts it off as high up as it can reach ; owing to the proximity of the surrounding grain the stem will not fall, the butt end drops to the ground and another cut is made about four inches up the stalk ; the process of cutting off sections of this length is repeated until the grain is within reach. Here, after a square meal, the mouse leaves a collection of straws about four inches long together with a shattered head of grain to puzzle the farmer.

Arvicola austerus, called by some authorities "prairie meadow mouse," is the rarest of all our mice here. We think Dr. Langdon very properly calls this species the "wood mouse," on account of its attachment for the more open woodland or the grassy fields or newly cleared land adjoining such. All the specimens taken here have been captured by a cat, hence we are unacquainted with its habits.

Owing to the fact that all of these species live in summer surrounded by luxuriant vegetation, much less is known of their summer habits than of their life in winter.

The species with which we are best acquainted occur at times

in great numbers, while other years they are very scarce. During the years 1878 and 1879 *Arvicola riparius* was very common and could be found in every locality, but in 1880 most of them disappeared, and for a long time they were very scarce. They have slowly increased in numbers and are now as numerous, perhaps, as ever. Whether these strange reoccurrences are the result of migrations or disease we are, from the present state of our knowledge, unable to determine.

Mice have their enemies, as do most other animals. They are caught in large numbers by the smaller hawks (*Tinnunculus sparverius* Vieill, *Accipiter cooperi* Bp., and *Accipiter fuscus* Bp.), owls (*Scops asio* Bp., and *Asio accipitrinus* Newton); cats and dogs catch them as opportunity affords. Many also are killed by their curious little enemies, the shrews.

In habits no two of the species named approach each other very nearly except in general characteristics. They all appear to be gregarious, living as a rule in colonies. The pine mouse burrows deepest, and makes the most lengthy runways. The passages made by Cooper's field mouse are never of much length, but are very sinuous and intricate. In food each species appears to partake of some particular kind or kinds found near the locality it frequents. Except in case of the pine mouse and Cooper's mouse the localities occupied by each species do not appear to overlap, each frequents a peculiar kind of region wherein it plays its part in the economy of nature.

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ON A PARASITIC COPEPOD OF THE CLAM.

BY PROFESSOR R. RAMSAY WRIGHT.

SINCE the researches of Dana, published between thirty and forty years ago, comparatively little attention has been given to the Copepoda in America. So much is this the case that Gerstæcker in his account of the geographical distribution of the order,[1] mentions only sixteen species as inhabiting the fresh waters and coast region of North America, the described forms being all fish parasites. Of late, however, important contributions to the knowledge of the fresh-water, free-living forms have appeared in this journal,[2] and new parasitic species have been

[1] Bronn's Thierreich, Vol. v, c. 1876, p. 799.

[2] S. A. Forbes. Entomostraca of Lake Michigan, Vol. XVI.
C. L. Herrick. Heterogenetic development in Diaptomus, Vol. XVII.

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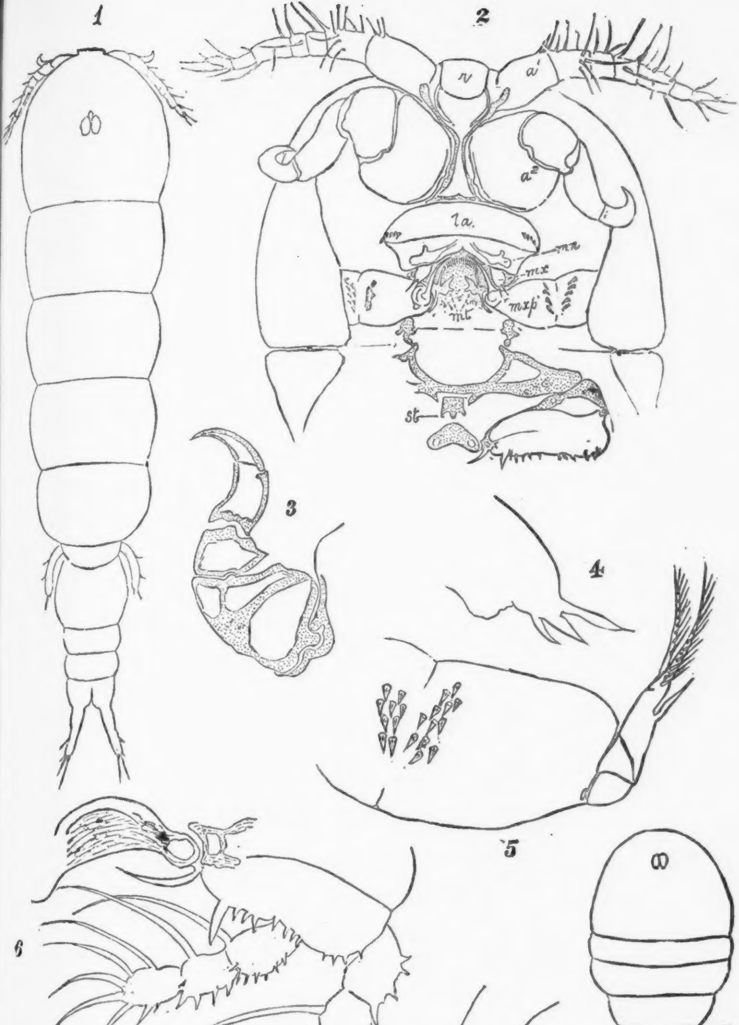
PLATE III.



A Copepod Parasite of the Clam

added by Kellicott[1] and myself[2] to the list of those already described.

That much remains to be done in this direction may be gathered from the common occurrence in the gill-tubes of the ordinary long clam (*Mya arenaria*) of an interesting form, so large as to occasion surprise that it has hitherto escaped notice.

At the recent meeting of the Am. Assoc. for the Advancement of Science in Philadelphia, I proposed the generic name Myicola for the copepod in question, and shall describe the species as *M. metisiensis*, from the village of Little Metis, on the Gulf of St. Lawrence, where the specimens were taken.

The order Copepoda affords most interesting material for the study of various grades of parasitism. At one end of the series are the completely free forms, at the other the completely parasitic, in the adults of which it is often impossible to recognize any resemblance to the copepod type. But no important gap exists in the whole series. Even among those with well-developed jaws (Gnathostomata of Thorell) the Notodelphyidæ only occur as commensals in the branchial sacs of tunicates, while before we reach the completely parasitic forms, where the mouth is converted into a sucking tube (Siphonostomata), we find a large number of forms (the Poecilostomata of Thorell), some free and some semiparasitic, where the parts of the mouth are evidently formed for piercing soft tissues and thus obtaining fluid nourishment.

To the last section belong the Corycæidæ, Sapphirinidæ, Lichomolgidæ, Ergasilidæ, to which groups some authors accord family rank, while others are disposed to regard them as constituting a single family (Corycæidæ). It may be stated generally that while the fish parasites are chiefly Siphonostomata, and the ascidian commensals chiefly Notodelphyidæ, the copepod parasites of the other groups of the animal kingdom—Mollusca, Vermes, Echinodermata, Cœlenterata—are largely Poecilostomata. Thus members of this group have been found on the gills of cuttlefishes, on the delicate branchiæ of nudibranchs, in similar situations on marine annelids and holothuroids, and on the soft tissues of sea-pens and other cœlenterates.

The clam parasite also belongs to the same group, as do all

[1] Proc. Am. Soc. Micros., II and IV.

[2] Proc. Can. Inst., N. S. Vol. I, p. 243.

the Copepoda parasitic on Mollusca with the exception of the Penella larvæ found on the gills of cuttlefishes, the Artotrogus from the egg-sacs of Doris, and certain species of Splanchnotrophus, which bore into the skin of nudibranchiates.

Hitherto, so far as I have been able to determine, only three cases of Copepoda parasitic on lamellibranchiates have been recorded, viz., *Anthessius solecurti* Della Valle, on the external surface of *Solecurtus strigillatus*,[1] *Modiolicola insignis* Aurivilius, from the gills of *Modiola vulgaris* and *Mytilus edulis*,[2] and *Paclabius tumidus* Kossmann, from the pericardium of Tridacna (Philippines),[3] I have not had access to the description of the last-named form, which belongs to the Ergasilidæ, and, according to Aurivilius, shares the great development of the cephalothorax, the absence of appendages on the fifth segment and the long egg-sacs with the genus Ergasilus. The two other forms are closely related to Lichomolgus, and apparently still more closely allied to each other, for a comparison of the figures shows that their most divergent characteristics, the mouth parts and the fifth pair of thoracic appendages, do not present greater differences than are to be met with in the range of the genus Lichomolgus.[4] Further investigation will show whether it is desirable to retain them in separate genera.

It will appear from the following generic diagnosis of the clam parasite that it occupies a position intermediate between Lichomolgus and Ergasilus:

Myicola, n. g.—Cephalothorax of ♀ *oblong*, of ♂ pyriform, composed of six segments, the last of which is *reduced in size* and carries a pair of uniramous appendages. Abdomen as in Lichomolgus. Anterior antennæ of seven joints, posterior of four, robust, the *basal joint tumid*, the terminal one *converted into a single strong claw;* mandible with triangular base and *several setose lobes*. Maxilla as in Lichomolgus. First pair of maxillipedes *robust*, three-jointed, the *basal joints tumid*, the terminal one carrying two setose filaments. Second pair of maxillipedes *absent in* ♀, resembling those of Lichomolgus in ♂. Natatory feet as in Anthessius and Modiolicola.

This genus approaches Ergasilus in the conformation of the posterior antennæ and in the absence of the posterior maxilli-

[1] Della Valle. Sui coriceidi parassiti, e sull'anatomia del gen. Lichomolgus. Mitth. Zool. Stat. Neapel, II, 102.

[2] Aurivilius. Bidrag till Kännedomen om Krustaceer som lefva hos Mollusker och Tunicater, pp. 9 and 39, Sep: imp: from "Oef: Kongl: Vet-Ak: Förh.," Stockholm, 39 Arg.

[3] Kossmann. Zool. Ergebnisse, Leipz., 1877.

[4] cf. Brady. Brit. Copepoda, Vol. III.

pedes in the female. In the proportionate size of the thoracic segments, the position of the mouth and the conformation of the natatory feet, it approaches on the other hand the Lichomolgidæ, and especially those forms already found in Lamellibranchiata. The dimorphism of the cephalothorax, which is more striking than in any of the allied genera, is no doubt to be attributed to the cylindrical form of the water-tubes of the gills in which the females live.

If Lichomolgus and the Saphirinidæ be merged into the family Corycæidæ, as seems the most natural arrangement (cf. Claus, Lehrbuch der Zoologie, p. 554; and Brady, Zoölogy of the *Challenger* expedition, Vol. VIII, p. 109, *et seq.*), then the existence of the above described genus renders imperative the acceptance of Della Valle's proposal to include Ergasilus in the same family (*l. c.* p. 83). So extended, the family of the Corycæidæ would embrace some free and some semiparasitic forms, some parasites of pelagic animals, and a few whose females at least are constant parasites of Pisces, Mollusca, Vermes and Cœlenterata.

The following description of the species will, with the help of the figures, serve to elucidate its most important characteristics:

Myicola metisiensis, n. sp. ♀ 3^{mm} long, of which 1^{mm} belongs to the abdomen, inclusive of the furca. ♂ 1.75^{mm} and less. First four free thoracic segments of ♀ subequal, broader than long, the fifth smaller than the first abdominal segment and chiefly developed dorsally. Thoracic segments of ♂ gradually decreasing in breadth from before backwards. Double genital segments of ♀ abdomen nearly as long as remaining three segments. The posterior borders of the genital and two following abdominal segments of ♂ denticulated. Furcal segments as long as two last abdominal; setæ six, of which three are apical and one subapical. Rostrum shield-shaped; anterior antennæ as long as the head, the first, second and fifth joints the longest. Posterior antennæ directed downwards; shorter than the anterior. Labrum with lateral borders denticulated, and posterior border emarginate. Mandible with two setose lobes and two setose filaments. Maxilla with three setæ, of which the mesal is longest. Two basal joints of anterior maxillipede tumid, with two converging oblique patches of spines, the distal joint with a strong seta and terminating in two curved setose filaments of which the slenderer is attached like a palp. Posterior maxillipede of ♂ with basal joint denticulated. Basal joint of 1st pair of natatory feet with a row of strong spines on the ventral surface, decreasing in strength on the 2d and 3d pairs, and absent on 4th; 5th pair uniramous, with three joints, the two proximal of which carry each a distal seta, while the distal has two apical setæ and a subapical group of spines.

Egg-sacs two, cylindrical, $1^{mm} \times 0.5^{mm}$.

Spermatophores subpyriform, $0.2^{mm} \times 0.1^{mm}$.

♀ parasitic in the gill-tubes of *Mya arenaria*, at Little Metis, Quebec, Canada.

♂ free in the mantle cavity of Mya.

I have not thought it necessary in the above diagnosis to give

an exhaustive account of the form of the appendages. If a second species of the genus should be found, diagnostic marks will be readily obtainable from the figures. The anatomy of the soft parts appeared to agree so completely with Della Valle's account of *Lichomolgus sarsii*, that I abstain from any description thereof.

There are two points of some interest which I have not referred to in the diagnosis. The mouth corresponds in position nearly to the notch of the labrum, and is situated between the points of the mandibles. Behind this point is a sort of vestibule bounded by the distal joints of the anterior maxillipedes, the dorsal wall of which is formed by the sternal surface between the basal joints of the mouth parts. A crescentic row of minute spines follows the curve of the maxillipedes, and two pointed chitinous processes project into the vestibule further back. These are connected with the chitinous framework surrounding the sockets of the mouth-parts. I have not had the opportunity of observing whether they play the part of teeth. They appear to me comparable to the lobes of the Metastoma (unterlippe) described by Claus[1] for Nereicola. A further agreement with that genus is the presence of a chitinous process which corresponds in position to the absent posterior maxillipede, and is no doubt a rudiment of that member.

I have met with no trace of the sixth pair of limbs described by Della Valle as projecting from the anterior half of the genital segment in Lichomolgus and do not hesitate to reckon all of the double genital segment to the abdomen.

The presence of female Myicolæ in the gill-tubes of a clam is readily detected by local swellings of the tube corresponding to the length of the parasites. With a needle they are readily freed, and swim about with considerable velocity considering that their legs have not been stretched since they were imprisoned in the gill. I am unable to say by what channel they reach their resting place. I have found some in the suprabranchial chambers, which would seem to indicate entry through the cloacal siphon, while I have found others, head upward, in the gill-tubes, which would appear to argue an entry, while still in the nauplius-stage, through the inhalant siphon and the water-pores of the gill-plates.

[1] Zeit: wiss: Zool., xxv, p. 342, pl. xxiii, fig. 21.

No considerable irritation appears to be set up by the presence of the parasite in the gill-tubes. The claws of the posterior antennæ and the setæ of the various appendages are often invested by a yellowish film undoubtedly derived from the blood of the host, but no greater exudation resulting in the formation of a cyst round the foreign body is to be observed, such as, *e. g.*, surrounds a Trematode sporocyst in a fresh-water mollusk. The granular contents of the intestine of the Copepod have a bluish-green tint, which is most readily noticed in the wider rectum, but I must leave undecided whether these are derived from the blood of the host.

The development of Myicola appears to resemble that of Lichomolgus closely. When I first collected the parasite in June, the eggs were in various stages of development; in August, when I was at liberty to study them, the females had lost their egg-sacs.

The difference in form of the male has been already referred to; the contrast in locomotion is just as striking; its movements are as rapid as those of a Cyclops. Further investigation must show how the females are impregnated. The presence of a well-developed posterior maxillipede in the male would appear to indicate that the female is clasped by these, while the spermatophores are attached to the genital orifice. If such is the case this must occur in the suprabranchial chamber before the female has become tightly wedged into a gill-tube.

Whether Myicola will turn out to be associated with *Mya arenaria* wherever the latter occurs, must be left for the future to decide. A search for Copepoda in other lamellibranchiates would probably yield other interesting forms, although they are hardly likely to be of such large size as the species at present described. I searched Mytilus and Mesodesma at Metis without detecting any such.

Some idea of the frequency of the copepod may be gathered from the circumstance that twenty-five females were obtained from fifteen clams out of forty examined.[1] Only one male was observed in this gathering, but their small size and comparatively free life favor their escaping notice. This observation, further, was made in August, when the females had, almost without ex-

[1] Three Malacobdellæ were found in the same.

ception, lost their egg-sacs. It is possible that the males would be more frequently met with in June or July.

EXPLANATION OF PLATE III.

(The drawings are all outlined by Zeiss camera lucida, and reduced by one-third.)

Fig. 1, Gundlach 1½″ × Zeiss Oc. II.
Figs. 2, 3, 8, Zeiss A × Zeiss Oc. II.
Figs. 4, 5, 6, 7, 10, Zeiss D × Oc. II.
Fig. 9, Zeiss Hom. Im. ⅛th × Oc. II.

FIG. 1.—*Myicola metisiensis* Ramsay Wright, ♀ from above.
" 2.—Head and part of 1st thoracic segment from below. *r*, rostrum, a^1, anterior, a^2, posterior antenna; *la*, labrum; *mn*, mandible; *mx*, maxilla; mxp^1, anterior maxillipede; *mt*, metastoma; *st*, the somewhat complicated sternal apparatus of the 1st pair of natatory feet.
" 3.—Posterior antenna, indicating the chitinous framework of the different joints.
" 4.—Maxilla.
" 5.—Anterior maxillipede.
" 6.—First pair of natatory feet.
" 7.—Fifth pair.
" 8.—♂ from above.
" 9.—Mandible of ♂.
" 10.—Posterior maxillipede of ♂.

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ON THE RUDIMENTARY HIND LIMB OF MEGAPTERA LONGIMANA.[1]

BY JOHN STRUTHERS, M.D.

THE author remarked that the interest attaching to the structure of whales depends largely on the fact that they present numerous rudimentary structures. Megaptera is extremely rare on British coasts. This one appeared in the Firth of Tay, and after sporting for some weeks in sight of the inhabitants of Dundee, was at last mortally wounded, and towed ashore dead, at Stonehaven, near Aberdeen, on January 8, 1884. It was a male, forty feet in length. The pectoral fin, the chief character of this species, was twelve feet in length. The parts containing the rudimentary hind limbs were removed and carefully examined in the anatomical rooms at Aberdeen. The presence of a rudimentary

[1] Abstract of a paper read before the biological section of the British Association for the Advancement of Science at Montreal, August, 1884.

thigh bone in this species had been discovered many years ago by the late Professor Reinhardt, of Copenhagen. The object of the author's inquiry was to ascertain the precise anatomical relations of this rudimentary structure, and if possible to throw some light on its meaning. For comparison the author exhibited to the section the rudimentary bony thigh bone, about the size of a hen's egg, which he had found in a great fin-whale, the razor back (*Balænoptera musculus*), in 1871, and a series of specimens of the more developed thigh bone and cartilaginous tibia, which he had dissected in the Greenland right whale (*Balæna mysticetus*), and his drawings of the ligaments and muscles connected with these parts in the right whale (*Jour. of Anat. and Phys.*, Jan. 7, 1881).

In this Megaptera he found the thigh bone to be entirely composed of cartilage, of a conical shape, the length five and a-half inches on the right side, four inches on the left. It was encased in a mass of fibrous tissue. This fibrous case was connected internally to its fellow of the opposite side; superficially and on the outside to the posterior pelvic muscular mass; and anteriorly, passing from the thigh bone itself, was a special band appearing like a fibrous prolongation of the bone. The thigh bone rested loosely on the pelvic bone without articular surface, but was bound loosely to the latter by a strong posterior ligament, and by a weaker ligament in the position of the hip joint in the right whale. A muscle about the size and shape of a forefinger, within a ligamentous tube, connected the thigh bone backwards to the great interpelvic ligament. This was the only muscular structure directly connected with the thigh bone. It would retract the bone. The fibrous connections of the bone were mainly adapted to resist outward and forward traction.

The author said, that looking to all these facts, the conclusion to which we must come is, that the thigh bone in Megaptera is a rudimentary structure, a vestige of a more complete limb possessed by some ancestral form from which the Megaptera is descended.

The skeleton of this Megaptera he hoped would be ready to be inspected by the members of the British Association at the meeting in Aberdeen in September, 1885.

ON FINGER MUSCLES IN MEGAPTERA LONGIMANA AND IN OTHER WHALES.[1]

BY JOHN STRUTHERS, M.D.

THE author's observation, showing the presence of finger muscles in Megaptera, was made on the individual beached at Stonehaven, near Aberdeen, on January 8, 1884, the description of the rudimentary hind limbs of which he had described at the meeting of the British Association at Montreal. The presence of muscles in the forearm of a whale had been first noticed by Flower (in *Balænoptera musculus*) in 1865, and described in the lesser fin-whale (*B. rostrata*) by Carte and Macalister in 1868, and by Perrin in 1870. The author had described these muscles in the *Journal of Anatomy and Physiology*, in *B. musculus*, in 1871; in *Hyperoödon bidens* in 1871 and 1873, and in the Greenland right whale, *Balæna mysticetis* in 1878. In *B. musculus* the muscles present were the flexor carpi ulnaris, flexor digitorum ulnaris, flexor digitorum radialis, and an extensor communis digitorum. *Hyperoödon bidens* is the first and as yet only toothed whale in which they have been found, except in the common porpoise, in which he found the flexor carpi ulnaris present. In Hyperoödon the extensor was divided into two, and much more developed than in *B. musculus*. In the Greenland right whale he found also an extensor carpi ulnaris and a flexor carpi radialis. In the narwhal, Beluga and common pilot whale (*Globicephalus melas*) he found these muscles to be present morphologically, but histologically represented by fibrous tissue and therefore reduced to the condition of ligaments.

Considering the enormous size of the pectoral fin in *Megaptera longimana*, he had been anxious to ascertain whether these finger muscles were present, and if so, whether they were more developed than in other finners, or more rudimentary. He found the same flexor muscles present as in *B. musculus*, but the two flexor muscles of the fingers, instead of being larger were together not half so large as in *B. musculus*. Also that the proportions of these two muscles were reversed, the ulnar flexor being about one-third the size of the radial flexor, instead of larger than it, as in *B. musculus*. The extensor aspect of the limb was not yet dissected, as he had had time just to examine the flexor aspect before

[1] Read before the American Association at Philadelphia, on Sept. 9.

leaving for Canada. The dissection of whales is no easy matter.

Here then we have these finger muscles in Megaptera not more developed in proportion to the size of the limb, but in a still more rudimentary condition. These facts, the author observed, could be reasonably explained only on the hypothesis of the descent of whales from some ancestor in which the fingers had more extensive movement.

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THE STRUCTURE AND DEVELOPMENT OF THE SUSPENSORY LIGAMENT OF THE FETLOCK IN THE HORSE, OX, &c.[1]

BY J. D. CUNNINGHAM, M.D.

THE author first alluded to the various examples which are found amongst the mammalian group of muscles becoming transformed into fibrous tissue and assuming the duties of ligaments. He had observed muscles thus metamorphosed in the foot of the pig, walrus, armadillo, elephant, &c., and Professor Struthers had, in a paper read before the British Association in Montreal, instanced a remarkable case in which a muscle in the rudimentary hind limb of a cetacean was completely converted into ligamentous tissue around its periphery whilst it remained muscular in its center.

The most remarkable examples of this muscle metamorphosis are to be found in the feet of the horse and ruminants. The suspensory ligament of the fetlock, as is well known, is muscular in its origin, and in every case its ancestry can be traced with the greatest clearness and precision. In the horse it is derived from the fibrous transformation of the two bellies of the flexor brevis medii, and if transverse sections are made of the ligament, the remains of these bellies may be observed in its midst in the form of two crescentic fleshy outlines placed side by side. Every here and there, however, the outlines are interrupted by patches of fat cells and degenerating muscular fibers. The suspensory ligament of the ox, sheep, &c., is derived from the fusion and fibrous transformation of the four fleshy bellies of the flexor brevis annularis and flexor brevis medii, and in transverse section these show as

[1]Abstract of a paper read before the biological section of the American Association for the Advancement of Science, in Philadelphia, 1884.

four circular outlines of muscular tissue, which are also broken in their continuity by fatty tissue and degenerating muscular fibers. The change, therefore, is effected by the fatty degeneration of the fleshy fibers of the muscles and the coincident increase of the connective tissue elements. It is an instance of a pathological process bringing about a morphological change.

The examination of these ligaments in their embryonic condition affords some interesting results. It shows that the amount of muscular tissue in their midst is proportionately greater than in the adult, and further, that so long as the embryo is *in utero* there is not the slightest tendency to fatty degeneration exhibited in this fleshy tissue. After birth, however, when the foot is called into play, and its requirements show a greater need in the suspensory ligament of fibrous than muscular tissue the change begins. The active change is thus confined entirely to the extra uterine life of the animal, but a condition is produced in the parent which affects the offspring. It is an admirable instance of the slow progress made by morphological changes and how processes of this nature are thrown back a stage in the embryo. Provided that the external circumstances which originally instituted the change remain unaltered, we may consider that there are two conditions at work, *conservative* in the embryo, *progressive* in the adult; but the latter has the advantage, inasmuch as it is aided by the influence of heredity. From this, therefore, we may argue that in the course of time the transformation of the suspensory ligament will become complete, and that ultimately not a trace of muscular tissue will appear in its midst. It is very evident, however, that the fleshy fibers will be longer of disappearing in the fœtus than in the adult.

——:o:——

THE WINOOSKI OR WAKEFIELD MARBLE OF VERMONT.

BY PROFESSOR GEO. H. PERKINS.

BEDS of primordial rock known as "the red sandrock" extend through Western Vermont from the northern limit of the State south into Shoreham where the formation disappears. Its breadth is nowhere very great, and it is chiefly confined to the immediate neighborhood of Lake Champlain. Here and there on the lake shore are bold headlands composed of this rock.

Most commonly it is a hard, dark red sandstone containing, besides a large percentage of silica, eight or nine per cent of potash, about the same of iron, and more or less of lime. The composition of the rock is not uniform, but differs greatly in different portions even of the same stratum.

The color, though chiefly dark red, is sometimes light red or even reddish-buff. Moreover the entire formation, which is about two thousand feet thick, includes limestones, dolomites, slates and shales, though the red sandrock is, in most places, by far the most conspicuous member of the formation, and forms the greater part of its thickness. Still, in some localities other beds make up a not inconsiderable portion of the whole, as the following section taken at Swanton by Sir William Logan, and given here with some modification, shows:

	Feet.
1. White and red dolomites (Winooski marble) with sandy layers;—some of the strata are mottled, rose red and white, and a few are brick red or Indian red. Some of the red beds contain *Conocephalites adamsi* and *C. vulcanus*..	370
2. Gray argillaceous limestone, partially magnesian, holding a great abundance of *Palæophycus incipiens*....................................	110
3. Buff sandy dolomite..	40
4. Dark gray and bluish-black slate, partially magnesian, with thin bands of sandy dolomite. The slate contains fossils as *Obollela cingulata*, *Orthisina festinata*, *Camerella antiquata*, *Conocephalites teucer*, *Paradoxides thompsoni*, *P. vermontana*..................................	130
5. Bands of bluish mottled dolomite, mixed with patches of gray pure limestone and gray dolomite and bands of gray micaceous flagstone with fucoids..	60

A mile or so north of the above section other strata, occur as follows:

6. Light gray more or less dolomitic sandstones and "some of which are fine grained, others are fine conglomerate." These are interstratified with bands of white sandstone....................................	630
7. Bluish thin bedded argillaceous flagstones and slates, containing *Conocephalites arenosus* and fucoids....................................	60
8. Bluish and yellowish mottled dolomite....................................	120
9. Yellowish and yellowish-gray sandy dolomite....................................	600

Still further north, on the Canada line, there are additional strata, though not well exposed, but in general Sir William gives them as follows:

10. Buff and whitish sandy dolomite, holding a great amount of black and gray chert in irregular fragments of various sizes up to a foot in length and six inches wide. There are also masses of white quartz. Thickness (conjectured)....................................	790

Most of the layers are not fossiliferous, and in few are fossils abundant. It may be true that fossils are really more common than they seem to be, for they only occur as casts, and, with the exception of the Algæ, these are rarely visible except when the surface of the stone has weathered so as to leave them in relief, and of course this only happens occasionally. Near Burlington, where the stone is extensively quarried for building purposes, some of the layers exhibit abundant casts of Algæ together with mud cracks, ripple marks and other evidences of shallow water formation. Farther north, at Georgia, and still more to the north at Highgate, various trilobites and Mollusca have been found of the genera Paradoxides, Conocephalites, Camerella, Orthisina, Obolella, &c. (see No. 4 above). The dolomitic portion of the beds constitute what has long been known as the "Winooski marble," to which I wish to call especial attention in the following pages.

The beds of "marble" appear first one or two miles north of Burlington and extend in a somewhat interrupted series north through St. Albans and end between that place and Swanton. Some of the layers are quite distinct from the red sandrock proper, others pass into it by imperceptible gradations. Ordinarily the marble beds are far less siliceous than the main bulk of the sandstone, often containing only one-seventh as much silica as that usually contains, or even less, but they are always much harder than ordinary marble. Analyses of the marble have been made but cannot be of great value when applied to the whole mass because the relative proportion of the substances composing it is extremely variable.

Identical results would scarcely be obtained from analyses of any two specimens taken at places a little distant from each other. Silica is always present, usually about ten per cent, lime carbonate forms from thirty to forty per cent, and magnesia carbonate about the same, while iron and alumina form a smaller portion of the mass.

No fossils had been discovered in this portion of the formation until a few years ago, when on looking over a pile of sawn fragments—refuse from the mill at Swanton—I noticed two or three pieces which contained evident fossils. These were afterwards identified by Mr. Billings as *Salterella pulchella,* described by him from the Straits of Belle Isle, and not hitherto known from Ver-

mont. It is only with difficulty that this fossil can be detected in uncut pieces of marble, but when blocks which contained specimens of it are sawn they are quite noticeable, as they are pure white and imbedded in the red stone, appear as small thimble-shaped, oval, conical or circular bodies, as they are cut in one or another direction. It seems probable that the Salterella occurs throughout the dolomitic beds, for I have found it at their extreme limits near Burlington and Swanton. The fossil is, however, not common anywhere. It occurs in patches sometimes as large as one's hand scattered over the slabs here and there. Other fossils also occur in the marble, but are not so well defined as to be certainly identified.

More than thirty years ago the beauty of the mottled dolomite attracted the attention of marble workers, and a quarry was opened about six miles from Burlington, and some of the blocks of stone taken out were sent to New York and Philadelphia to be sawn into slabs and polished. The results were, I believe, satisfactory in every way except financially. The stone made beautiful slabs for table tops and mantels, but its hardness, while adding to the beauty of the polish which it received, rendered the sawing and finishing so costly that after a short time the attempt to place it in the market was abandoned.

Later quarries were opened near St. Albans, and from these large quantities of stone have been taken, most of it to be manufactured at Swanton into floor tiling, for which it is admirably adapted. This enterprise still continues and has always been prosperous.

The most important attempt yet made to quarry and work up the Winooski marble was begun by a strong company only a short time ago at the old quarries near Burlington.

This company have large capital and have already made such thorough and extensive preparations to prepare the marble for market that if success can be attained in this direction it would seem certain to follow these efforts. Unfortunately, I think, this company have dropped the well-known name "Winooski marble," and substituted that of "Wakefield variegated marble," styling themselves the Wakefield Marble Company. It is no part of my purpose to advertise this company (though every one who knows of what it has accomplished and is trying to accomplish, and who is interested in the development of the resources

of the country, must be ready to wish it all success), for this would obviously be wholly out of place here. I think, however, that the possibility of obtaining at a not too great cost an abundant supply of beautiful marble which is unlike any other American marble, and which is fully equal to the finest imported marble for purposes of interior decoration, is a matter of interest to all. This is especially true because of the increasing rarity and costliness of imported marbles, and also because of the increasing demand for colored marbles in fine public buildings. That the Vermont variegated marble is fully equal to that which is imported is, so far as I know, the opinion of all experts who have examined both. In a pamphlet issued by the Wakefield company there are published letters from architects and marble workers which most emphatically declare this to be the fact. The late Hon. Geo. P. Marsh, in a letter written about a year before his death, says: "I have just returned from the national exposition at Florence. * * The brilliant reddish marbles are now very rare; and there was at the exposition none of the reddish class by any means equal to the Wakefield except in small fragments in mosaic work and the Sicilian jaspers."

The Wakefield or Winooski marble has been used in many public buildings in different portions of the country, notably in some of the corridors at the capitol at Albany as wainscoting, and also in the new wing of the Astor library in New York. It should be noticed here that while this marble is unrivaled for inside work it is not well adapted to situations in which it is exposed to the weather, as its colors fade and its beauty is greatly impaired when thus exposed. There seems to be great inequality in this respect in blocks from different layers. At least this is indicated in the appearance of blocks that have been for some years lying about the quarries. Some of these appear to be but very little changed, while others have their surfaces reduced to a nearly uniform yellowish-red. No one need fear any change in the appearance of polished slabs when protected from the inclemency of the weather.

Before attempting any description of the varieties of marble found in the Wakefield and other quarries, it may be well to notice some of the quarries themselves. The most extensive deposits are about the shores of Malletts bay, one of the most picturesque of the many lovely bays which indent the shores of

Lake Champlain. This bay is several miles in length and width and the marble crops out in cliffs from one hundred to two hundred feet high on both sides and forms islands in its midst. The supply is practically unlimited, and so located that huge blocks can be separated from the beds in the quarry, and by the same derrick which lifts them from these beds they may be placed in canal-boats or barges which may convey them by lake, canal and river either to New York or Montreal. In some parts of the cliffs the strata are easily separable, in other parts less easily, but almost anywhere large blocks, which prove sound and perfect throughout, may be obtained.

Perhaps the most remarkable characteristic of this marble is the wonderful variety of shade and general appearance which it presents.

Not only may slabs which are quite unlike each other be obtained from a block as it is sawn parallel with the stratification or transverse to it, any variation in the direction of the saws giving variety in the slabs; but even the opposite surfaces of the same slab may differ greatly. The rock in some of the layers is a more or less complete breccia, white or light-colored fragments being enclosed in a dark red paste. These fragments are of all sizes from those several inches long and wide to those no larger than the head of a pin. In some cases several adjacent bits were, when first held in the paste, one large piece, and subsequently broken, as the fractured edges of each exactly correspond to those of the pieces next it. The brecciated structure is conspicuously perfect in some blocks and quite imperfect in others, and it finally passes into what was evidently a pasty mass of nearly uniform fineness before consolidation took place. Some of the beds appear to have been much more thoroughly worked over, and the materials more completely ground and mixed than others, and the different varieties are in part due to this.

While but few colors are seen in the different layers, nevertheless these are mingled in such varying proportions as to produce unlimited diversity. Shades of red are especially abundant, so that almost every conceivable tint is found; less common are green, chiefly in olive shades, drab and rarely yellow, all mingled more or less abundantly with white. The different specimens may conveniently, though without absolute exactness, be arranged in several series. One of these would embrace those slabs in

which the red, which in most cases is the predominating color, is clear and decided. In this series we have many varieties from those in which the red is like that of jasper, or what is known as Indian red, to those in which it is simply a delicate pink like the lining of a shell. Another series gives us the red always of a brownish or chocolate cast, and this is sometimes very dark. This in turn passes through all intermediate shades to almost white. In a third series the red shades are less conspicuous, and with them are mingled greens and greenish-drabs or sometimes lavender shades. It is easy to understand how endless variation may be produced by varying combinations of these different shades with white. This is true both in the blotched and in the shaded layers. Those which show the brecciated structure more or less clearly vary as the fragments are large or small, and whether many large are mingled with many small or the reverse, and whether many large light fragments are mixed with dark small ones, or large dark bits with light small ones, and in the clouded or shaded layers light bands and blotches may predominate in one slab and dark bands in another. It will be obvious that no description of such marbles can convey to those who have not seen them very clear ideas of their appearance, and no attempt to describe all or nearly all of those found will be made. The company have for their own convenience and the purposes of trade, given names to over thirty varieties, all of which may be obtained within a very short distance from their mill on Malletts bay. A few of the leading sorts may properly be mentioned, and perhaps it will not be impossible to give a general idea of some of them. Nearest Burlington there are layers which possibly should be regarded as connecting the marble beds with the ordinary red sandrock. These are chiefly of a dark red slightly clouded and sprinkled with little grains of transparent quartz. This is veined with narrow veins of pure white lime carbonate, which is in pleasing contrast with the red about it. More rarely these veins are of quartz. The veins are usually not at all numerous, and often are only a small fraction of an inch in width. None of the varieties is so hard or so difficult to polish as this, and though handsome it is little used. An allied variety exhibits the white not as distinct veins but as mingled so completely with the red as to give a clouded appearance. Of course in the layers that are brecciated the colors are more or less distinct from each

other, and this is also true in some that show no breccia, for in these the colors are in blotches which may not blend to any great extent. One of the most richly shaded of all the varieties is what has been called "Ethan Allen." In this the clear red shades are in wavy bands, dark and light closely intermingled and constantly varying. Across these bands or waves are fine lines of clear white. This variety is finest when in large slabs, and as it receives a very brilliant polish it is very elegant. Some of the chocolate varieties are also very fine, and are admirably suited for wainscoting, mantels or other uses in rooms finished with dark woods. Of the lighter varieties of marble there are many. One of these is called "Florentine." In this the darker shades are mostly wanting, but the surface is covered with irregular blotches, usually not of large size, which are of a delicate pink or flesh color; with these are blotches of light tan and lavender, the whole mingled with white. Running across and through the blotches are lines of dark green. The effect of this combination of colors when a slab is polished is exceedingly beautiful. The "Bonfanti" is somewhat similar. The darker shades of red appear only as lines or small spots. The prevailing tints are pink, flesh color and salmon exquisitely mingled and blended with white and with each other. "Princess" is even more delicate and beautiful with its dainty blotches of lavender and ashes of roses, which give to the whole their peculiarly pleasing tints, while mingled with these are pink, salmon and rose shades and white.

A peculiar variety is "Opal." In this the red tints are largely absent, their place being taken by drabs and white. All of these pretty marbles receive without great difficulty a splendid polish, far more brilliant and durable than that of most of the white or clouded marbles. They are not easily scratched, do not grow dingy and are not stained readily. Ink and many other liquids, so injurious to the more completely calcareous marbles, does not affect these Wakefield varieties in the least. These advantages, aside from their great beauty, amply compensate for the greater cost of the harder marble. While, as has been shown, variety rather than uniformity is the rule among slabs of Wakefield marble, so that out of the hundreds of slabs which may be seen at any time in the store house of the company, no two can be found which are precisely alike (unless they were facing each other in

the block, for, of course, when the saw goes through a block the surfaces on each side of it must be alike), yet in most cases it is not very difficult to find a series sufficient for the wainscoting of a large room or the top of a long counter which match closely enough for all practical purposes.

While it has been my aim in what has been said of the different varieties mentioned to convey some idea of what they are, it is wholly impossible to place their beauty before the reader. No agate or jasper is more elegant or attractive. Indeed, in looking over slab after slab of the marble I have often been reminded of the close resemblance to agate which the surface before me presented. The Wakefield marble is, much of it, very similar to agate in brilliancy of polish, delicacy of color and general appearance, though quite unlike it in hardness and costliness. Nor do we ever see slabs of agate five or six feet wide and eight or ten feet long, as are some of the slabs of this marble.

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A BOTANICAL STUDY OF THE MITE GALL FOUND ON THE BLACK WALNUT.[1]

BY LILLIE J. MARTIN.

DEVOTEES to at least four sciences may do original work on *Erineum anomalum*. Since eggs have been found among the hairs on its surface and neither mycelium nor spores occur in it, it can no longer be ranked among the fungi, and the entomologist alone may study the life-history of its inhabitants. The chemist and physicist will certainly have somewhat to do if they set out to find the forces which are at work in the production of the gall. Nor will the botanist be without employment if he trace its anatomy and full development. This paper is a statement of what was seen in a somewhat superficial botanical examination of the gall during the month of July.

These galls usually occur in the walnut on the under side of the main petiole, somewhat below the first set of leaflets, but are occasionally found somewhat higher up. One or even seven or eight galls may be found on the same petiole (Figs. 1, 2, 3). When but one occurs the petiole is shortened and the leaf is rather smaller than the normal leaf; sometimes the petiole is slightly

[1] Read before the Section of Biology of the American Association for the Advancement of Science in the Philadelphia meeting, 1884.

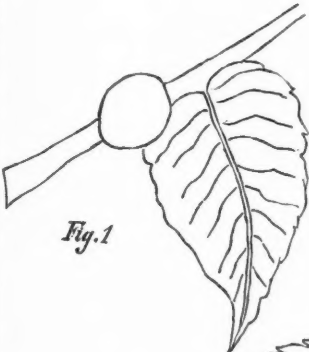

Fig. 1

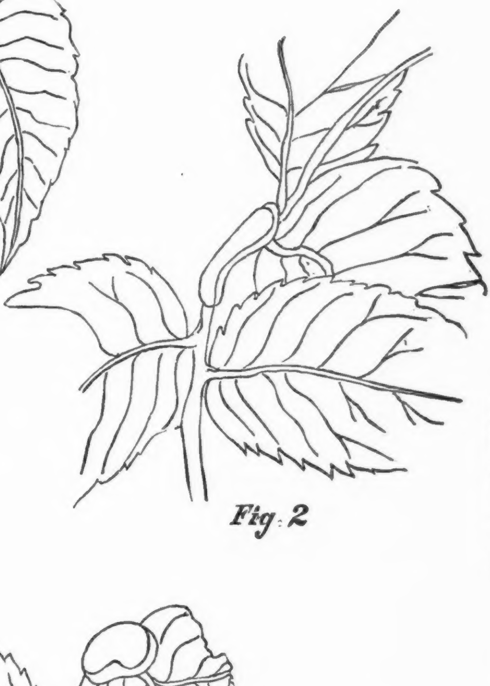

Fig. 2

Fig. 4

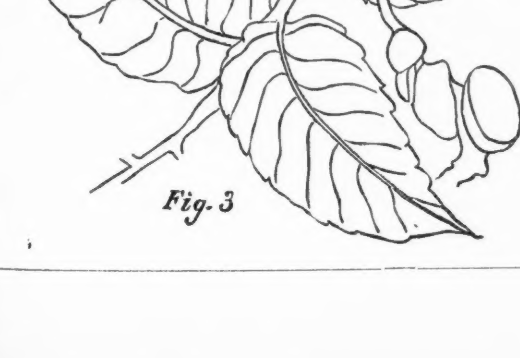

Fig. 3

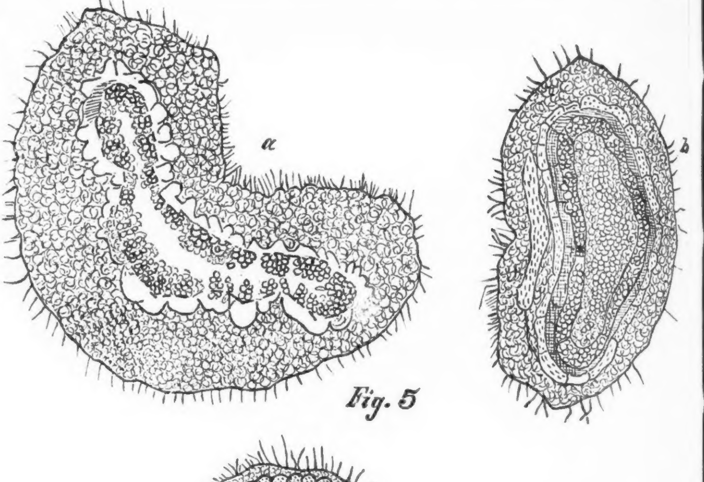

Fig. 5

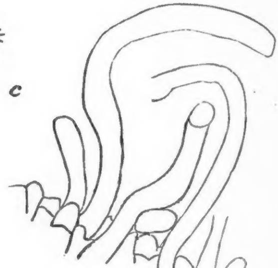

Fig. 8

Fig. 6

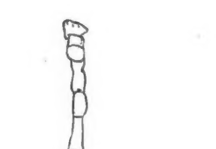

Fig. 7

bent from back to front also. In addition to these changes, when several galls are found on the same petiole (Fig. 3) this is often so much twisted as to bring them on the upper side of the leaf.

The galls are elliptical in shape, the longer axis varying in length from 3^{mm} to 15^{mm} and the shorter from 1^{mm} to $8^{mm.}$ From above they appear slightly convex; their centers are hairy and purplish-red in color and set in a green ring which is continued below into the petiole. Their average height is about $10^{mm.}$ In appearance they are not unlike buttons which have their tops mounted in metal holders.

The under surface of the gall is similar in general outline to its upper, as it abruptly contracts before passing into the petiole (Fig. 4), sometimes nearly clasping it either in the direction of its long or short axis. When several galls grow on the same petiole they may either run together or be entirely separate. If they coalesce great changes in size and shape are produced.

The normal petiole is usually horizontal, but sometimes twists the leaf half way round (herbarium specimens). The cross section of the petiole near its base is of a reniform shape on account of a crease in its upper surface. The crease disappears further from the base of the petiole, which then appears elliptical in cross section.

The fibro-vascular bundles of the normal petiole of the walnut are such as are ordinarily found in the stems of dicotyledonous plants. The bundle is better developed as the apex of the petiole is approached. Even here, however, the bast is more abundant than the corresponding wood. An examination of that part of the petiole where the crease has disappeared shows a second row of well developed fibro-vascular bundles. Almost no trace of this can be seen in the lower part of the petiole (Fig. 5).

Under a low power of the microscope a longitudinal radial section of that part of the gall near the pith of the petiole resembles a drawing of a geological section of the earth in which the strata are very much bent and folded (Fig. 10). The cells themselves are bent, but the folding takes place mainly between contiguous cells. In comparing cross and longitudinal-radial sections of the gall (Figs. 9 and 10) the bast is found to be quite as abundant as in the normal petiole, but is spread over a wider area. The wood, too, is as scanty as before. The tracheary vessels have almost entirely disappeared. Tracheids have not only

supplied their place but mainly compose that part of the gall that is made up of folded tissue. Two or three layers of the pitted cells near the pith are wider than long and regular in shape.

As the distance from the pith increases the cells increase in length and decrease in breadth until they are two or three times longer than broad. Owing to the crowding to which they are exposed, they become irregular in shape nearer the surface of the fibro-vascular bundle.

In the normal petiole the cells overlying the fibro-vascular bundle are longer than broad, regular in shape and contain but little protoplasm. The corresponding part in the galls is made up of much larger cells, irregular in form and filled with a granular substance which is slightly colored yellow by iodine, and red by eosin.

Clustered and glandular hairs are found irregularly distributed over the petiole. The clustered hairs (Fig. 6) are found abundantly on the upper side of the petiole near its base. From this point their number decreases though there are still more on the upper side of the petiole than on the lower. They originate from cells of the epidermis which have crowded together in papilla-like masses. But one hair arises from each cell. Each papilla may have but one hair, though it will often have nine or ten. The ordinary number is five or six. The hairs themselves are one-celled and pointed toward the apex. At the extremity their walls are so thickened as to nearly obliterate the cavity. They are thinner towards the base, and iodine shows protoplasm to be present.

The glandular hairs vary in shape. In a general way they are made up of several cells, the terminal cell being larger than those below, and secreting an "acrid aromatic" substance. Iodine shows that there is protoplasm in their cells. These glandular hairs arise from single epidermal cells which are separate from each other by two or three intervening cells.

The galls have no differentiated epidermis. Certain cells which from their position would be called epidermal are without protoplasm, but in other respects resemble those beneath. From nearly every one of the epidermal cells cylindrical, one-celled hairs arise (Fig. 8). These hairs seem to be a continuation of the epidermis. They are about 1^{mm} in length and $\frac{1}{10}{}^{mm}$ in diameter, that is, at least twice as long and broad as the normal hairs.

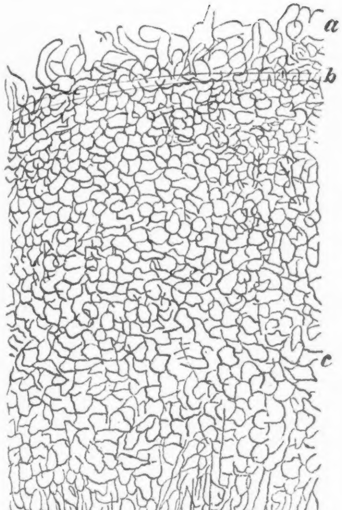

Fig. 9

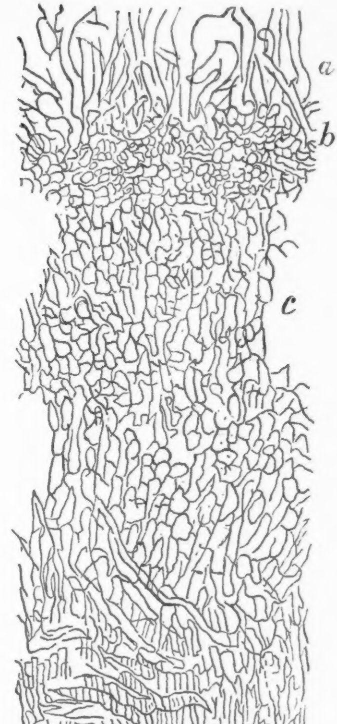

Fig. 10.

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These cells contain a purplish-red coloring matter which is soluble in water. If this is removed the cells are found to contain a large quantity of a brown granular substance. The hairs of the gall are so unlike normal hairs in shape, position, contents and origin that they can scarcely be looked upon as modified trichomes. Ensconced among the hairs which are distributed over the surface of the gall are found the eggs of the mite which produces it.

In order to know the changes which the gall has undergone in reaching its mature state, it would be necessary to make a careful study of the specimens of the gall from its first appearance to its full development. I hope to do this in the future. Possibly it may not be too presumptuous to venture a few predictions founded on a comparison of the gall with the normal petiole in regard to development:

1. The gall must have started very early. The fact that the gall hairs cannot be looked upon as modified trichomes has been already referred to. Vestiges of the normal trichomes would be found among the gall hairs if the petiole had been far enough advanced for them to appear, but no such remains are found. The epidermal cells of the gall are so thin-walled and so unlike the thick-walled and regular epidermal cells of the petiole in form, that they could have originated from them only at an early period. Comparison of the tissue beneath the epidermis in the gall and petiole does not suggest that one was derived from the other.

2. The development was doubtless inward, the stimulant, no matter of what nature, acting on the outside. The position of the eggs, the mode of oviposition of mites and the fact that no sign of their having pierced the tissue can be found, suggests this. The bending and folding of the fibro-vascular tissue would seem to suggest that the stimulant caused a greater growth in length than in breadth, and this produced the lateral pressure which pushed up the tissue.

3. The value of these various modifications to the mite may be seen in a general way. The hairs of the gall give the very best protection to the eggs, the parenchyma is an excellent cushion and is firmly supported by the tracheids which, with the other

portions of the fibro-vascular systems may also serve their usual purpose of conductors of water.

EXPLANATION OF PLATES.

PLATE IV.

FIG. 1.—Sketch of a gall showing its ordinary form, size and position. Natural size.

FIG. 2.—Sketch of the gall showing its appearance when found above the first set of leaflets.

FIG. 3.—Several galls on the same petiole showing the effect on stem and the general arrangement and shape of the galls when more than one occurs on the same petiole.

FIG. 4.—Cross section of gall and petiole, showing internal appearance of gall.

PLATE V.

FIG. 5.—Cross sections of normal petiole; *a*, at base, no well-developed second row of fibro-vascular bundles; *b*, below first pair of leaflets, appearance of second row of fibro-vascular bundles; *c*, above first pair of leaflets, a well-developed second row of fibro-vascular bundles. × 25.

FIG. 6.—Clustered hairs. × 165.

FIG. 7.—Glandular hairs. × 165.

FIG. 8.—Gall hairs, extensions of epidermal cells.

PLATE VI.

FIG. 9.—Cross section of petiole and gall; *a*, gall hairs which appear to be continuations of the epidermis *b*; *c*, parenchyma beneath the epidermis; *d*, fibro-vascular bundles in which tracheids have supplied the place of tracheary and other vessels; *e*, parenchyma of the pith (highly magnified).

FIG. 10.—Longitudinal-radial section of petiole and gall; *a*, *b*, *c*, *d*, *e*, as in fig. 9 (highly magnified).

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ON THE EVOLUTION OF THE VERTEBRATA, PROGRESSIVE AND RETROGRESSIVE.

BY E. D. COPE.

I. PRELIMINARY.

IN attempting to ascertain the course of evolution of the Vertebrata, and to construct phylogenetic diagrams which shall express this history, among the difficulties arising from deficient information, one is especially prominent. As is well known, there are many types in all the orders of the Vertebrata which present us with rudimentary organs, as rudimental digits, feet or limbs, rudimental fins, teeth and wings. There is scarcely an organ or part which is not somewhere in a rudimental and more or less useless condition. The difficulty which these cases present is, simply, whether they be persistent primitive conditions, to

be regarded as ancestral types which have survived to the present time, or whether, on the other hand, they be results of a process of degeneration, and therefore of comparatively modern origin. The question, in brief, is, whether these creatures presenting these features be primitive ancestors or degenerate descendants.

In the first place let us define the meaning of the word degenerate. This must be done first from a structural or anatomical standpoint. Degeneracy may be defined as a loss of parts without corresponding development of other parts. All animals are degenerate in some respect or another, as, for instance, the Mammalia in the small size of the pineal gland and of the coracoid bone; so that degeneracy, as a whole, can only be affirmed where the sum of the subtractions is greater than the sum of the additions. Function of the parts must, however, be consulted in this matter. We naturally regard sensibility as the highest of animal functions, and mind as the highest form of sensibility. Therefore development of organs of sensibility and sense and mind constitutes a better claim of progress than development of stomach or of skin. Since motion is under the direction of sensibility, organs of movement have much to do with the question. When perfection in this respect conflicts with perfection of brain, in evidence of position, we naturally give the preference to the latter in deciding. Thus the ruminating mammals are much superior to man in the structure of their feet, teeth and stomach, yet we properly assign the higher position to the quadrumana and to man, on account of the superior complication of their brain structure.

Palæontology has proven[1] what had been already surmised, that the development of animal organisms has been on lines of increasing specialization of parts. That is, in lines of increasingly perfect adaptations of structures to ends, or functions. In certain series of animals we witness steadily increasing perfection of mechanisms of the limbs for running; in others for digging; in others for flying. In the teeth we find increasing perfection of machines for grinding, for cutting or for seizing. In the brain the specialization has evidently been towards increased acuteness of perception, increased energy of action, and increased intelligence. Specialization does not, however, necessarily imply progressive development. Adaptation may be to a parasitic or a

[1] Cfr. "On the Evidence for Evolution in the History of the Extinct Mammalia;" Proc. Amer. Assoc. Adv. Sciences for 1883.

sessile mode of life. Such adaptation is often displayed in a very special modification of parts, as in the anterior limbs of some of the parasitic Crustacea; in the mouth parts of some Arachnida; in the feet of the sloth, and in the jaws of the ant-eaters.

Embryology has furnished, and will furnish, many important hints and demonstrations as to the true meaning of the rudimentary condition or absence of parts, and thus indicate the phylogenetic connections of animals. Thus the origin of the Tunicata from primitive vertebrate-like forms would probably never have been suspected but for embryological studies; and the origin of the very peculiar order of Rotifera has been explained in like manner. But embryology has its limitations, for the transitional characters presented by embryos are only partially of the nature of a record of the structures which belonged to their ancestors in successive geological ages, and are frequently special adaptations to the necessities of their embryonic life. Such are the statoblasts which are present in fresh-water sponges and Polyzoa, and wanting in the marine forms; and the allantois and placenta of Vertebrata. In a number of groups the embryo seems to have been more susceptible to the influence of the environment than the adults.[1] It results that in many cases the phylogeny can only

[1] A remarkable instance of this state of things appears in the history of the evolution of the insects. It is quite impossible to understand this history without believing that the larval and pupal states of the highest insects are the results of a process of degeneracy which has affected the middle periods of growth but not the mature results. The earliest insects are the Orthoptera, which have active aggressive larvæ and pupæ, undergoing the least changes in their metamorphosis (Ametabola) and never getting beyond the primitive mandibulate condition at the end. The metamorphosis of the jawed Neuroptera is little more marked, and they are one of the oldest orders.

The highest orders with jaws undergo a marked metamorphosis (Coleoptera, Hymenoptera), the Hymenoptera even requiring artificial intervention in some instances to make it successful. Finally the most specialized orders, the suctorial Diptera and Lepidoptera, especially the latter, present us with very unprotected more or less parasitic stages, both active and inactive. These animals have evidently degenerated, but not so as to prevent their completing a metamorphosis necessary for purposes of reproduction. As is well known, many imagines (Saturniidæ, Œstridæ) can perform no other function, and soon die, while in some Diptera the incomplete larvæ themselves reproduce, so that the metamorphosis is never completed.

This history is parallel to that proposed by Dohrn to account for the origin of the Ammocœtes larval stage of the Marsipobranchii. He supposes this form to be more degenerate than its probable ancestral type in the ancestral line of the Vertebrata, as it is inferior to its own adult. An inactive life in mud is supposed by Dohrn to have been the effective cause. An inactive life on the leaves of plants, or in dead carcases, has probably been the cause of the same phenomenon in the Lepidoptera and Diptera.

be determined by the discovery and investigation of the ancestors themselves, as they are preserved in the crust of the earth. In all cases this discovery confirms and establishes such definite conclusions as may be derived from embryology. It is also clear that on the discovery of phylogenetic series it becomes at once possible to determine the nature of defective types. It becomes possible to ascertain whether their rudimental parts represent the beginnings of organs, or whether they are the result of a process of degeneration of organs once well developed.

A great deal of light has been happily thrown on this question as regards the Vertebrata, by the recent work done in North American palæontology. The lines of descent of many of the minor groups have been positively determined, and the phylogenetic connections of most of the primary divisions or classes have been made out. The result of these investigations has been to prove that the evolution of the Vertebrata has proceeded not only on lines of acceleration but, to a much greater extent than has been heretofore suspected, on lines of retardation.[1] That is, that evolution has been not only progressive, but at times retrogressive. This is entirely in accord with the views derived by Dohrn from embryology,[2] who, however, wrote only of the origin of the Vertebrata as a whole and not of its divisions, excepting only the Leptocardii and Marsipobranchii, that is, of the sand lance and the lampreys and hags. The demonstration of such relations for the higher Vertebrata is now done nearly for the first time.[3]

Omitting from consideration the two classes above mentioned, whose remains have not yet been certainly found in a fossil state,

[1] See Origin of Genera, E. D. Cope, Philadelphia, 1868, where these terms are introduced.

[2] See Der Ursprung der Wirbelthiere u. d. Princip des Functionwechsels, Leipsic, 1875.

[3] On the Phylogeny of the Vertebrata, Cope, AMER. NATURALIST, Dec., 1884. I here remark that my researches have now, as I believe, disclosed the ancestry of the mammals, the bird, the reptiles and the true fishes, or Hyopomata, including the special phylogenies of the Batrachia and Reptilia, and some of the Mammalia. See the following references: AMERICAN NATURALIST, 1884, p. 1136; Proceedings Academy Philadelphia, 1867, p. 234; Proceedings American Philosoph. Society, 1884, p. 585; AMERICAN NATURALIST, 1884, p. 27; Proceedings American Association for the Advancement of Science, XIX, 1871, p. 233; Proceedings American Philosophical Society, 1882, p. 447; AMERICAN NATURALIST, 1884, pp. 261 and 1121; Report U. S. Geol. Survey W. of 100th Mer., G. M. Wheeler, 1877, IV, II, p. 282.

there remain the following: the Pisces, Batrachia, Reptilia, Aves and Mammalia.

The Mammalia have been traced to the theromorphous reptiles by the Monotremata. The birds, some of them at least, appear to have been derived from the Dinosaurian reptiles. The reptiles in their primary representative order, the Theromorpha, have been probably derived from the rhachitomous Batrachia. The Batrachia have originated from the sub-class of fishes, the Dipnoi, though not from any known form. I have shown that the true fishes or Hyopomata have descended from an order of sharks,[1] the Ichthyotomi, which possess characters of the Dipnoi also. The origin of the sharks remains entirely obscure, as does also that of the Pisces as a whole. Dohrn believes the Marsipobranchii to have acquired its present characters by a process of degeneration. The origin of the Vertebrata is as yet entirely unknown, Kowalevsky deriving them from the Ascidians, and Semper from the Annelida. The above results I have embodied in the following phylogenetic diagram:

Aves Mammalia

Reptilia

Hyopomata Batrachia

Pisces { Selachii Ichthyotomi Dipnoi

Holocephali

Marsipobranchi

Leptocardii

Accepting this phylogeny, it becomes possible to determine the course of development first of the whole series; and secondly of the contents of each class taken by itself. I will first consider the direction of the evolution of the Vertebrata as a whole.

II. The Vertebrate Line.

The Vertebrata exhibit the most unmistakable gradation in the characters of the circulatory system.[2] It has long been the

[1] Proceedings Am. Phil. Soc., 1884, p. 585.

[2] See Origin of Genera, 1868, p. 20, for a table of the characters of the circulatory system.

custom to define the classes by means of these characters, taken in connection with those of the skeleton. Commencing in the Leptocardii with the simple tube, we have two chambers in the Marsipobranchii and fishes; three in the Batrachia and Reptilia; and four in the Aves and Mammalia. The aorta-roots commence as numerous pairs of branchial arteries in the Leptocardii; we see seven in the Marsipobranchi, five in the fishes (with number reduced in some); four and three in Batrachia, where they generally cease to perform branchial functions; two and one on each side in Reptilia; the right hand one in birds, and the left hand one in Mammalia. This order is clearly an ascending one throughout. It consists of first, a transition from adaptation to an aquatic to an aërial respiration; and second, an increase in the power to aërate and distribute a circulating fluid of increased quantity, and of increased calorific capacity. In other words, the circulation passes from the cold to the hot-blooded type coincidentally with the changes of structure above enumerated. The accession of a capacity to maintain a fixed temperature while that of the surrounding medium changes, is an important advance in animal economy.

The brain and nervous system also display a general progressive ascent. Leaving the brainless Leptocardii, the Marsipobranchs and fishes present us with small hemispheres, larger optic lobes and well-developed cerebellum. The hemispheres are really larger than they appear to be, as Rabl Rückard has shown[1] that the supposed hemispheres are only corpora striata. But the superior walls are membranous, and support on their internal side only a layer of epithelial cells, as in the embryos of other Vertebrata, instead of the gray substance. So that although we find that the cerebellum is really smaller in the Batrachia and most Reptilia than in the fishes, the better development of the hemispheres in the former gives them the preëminence. The Elasmobranchii show themselves superior to many of the fishes in the large size of their corpora restiformia and cerebellum. The Reptilia constitute an advance on the Batrachia. In the latter the optic thalami are, with some exceptions, of greater diameter than the hemispheres, while the reverse is generally true of the reptiles. The crocodiles display much superiority over the other

[1] Biologisches centralblatt, 1884, p. 449

reptiles in the larger cerebellum, with rudimental lateral lobes. The great development of the hemispheres in birds is well known, while the general superiority of the brain of the living Mammalia over all other vertebrates is admitted.

The consideration of the successive relations of the skeleton in the classes of vertebrates embraces, of course, only the characters which distinguish those classes. These are not numerous. They embrace the structure of the axis of the skull; of the ear bones; of the suspensors of the lower jaw; of the scapular arch and anterior limb, and of the pelvic arch and posterior limb. Other characters are numerous, but do not enter into consideration at this time.

The persistence of the primitive cartilage in any part of the skeleton is, embryologically speaking, a mark of inferiority. From a physiological or functional standpoint it has the same significance, since it is far less effective both for support and for movement than is the segmented osseous skeleton. That this is a prevalent condition of the lower Vertebrata is well known. The bony fishes and Batrachia have but little of the primitive cartilage remaining, and the quantity is still more reduced in the higher classes. Systematically then, the vertebrate series is in this respect an ascending one. The Leptocardii are membranous; the Marsipobranchii and most of the Elasmobranchii cartilaginous; the other Pisces and the Batrachia have the basicranial axis cartilaginous, so that it is not until the Reptilia are reached that we have osseous sphenoid and presphenoid bones, such as characterize the birds and mammals. The vertebral column follows more or less inexactly the history of the base of the skull, but its characters do not define the classes.

As regards the suspensor of the lower jaw the scale is in the main ascending. We witness a gradual change in the segmentation of the mandibular visceral arch of the skull, which clearly has for its object such a concentration of the parts as will produce the greatest effectiveness of the biting function. This is accomplished by reducing the number of the segments, so as to bring the resistence of the teeth nearer and nearer to the power, that is, the masseter and related muscles, and their base of attachment, the brain-case. This is seen in bony Vertebrates in the reduction of the segments between the lower jaw proper and the skull, from four to none. In the fishes we have the hyomandibular, the sym-

ERRATUM.

FEBRUARY NATURALIST.

Page 147, second line from bottom, omit "Batrachia."

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plectic, the inferior quadrate, and the articular. In the Batrachia, reptiles and birds, we have the quadrate and articular only, while in the Mammalia, these elements also are wanting.

The examination of the pectoral and pelvic arches reveals a successive modification of the adaptation of the parts to the mechanical needs of the limbs. In this regard the air-breathing types display wide diversity from the gill-bearing types or fishes. In the latter, the lateral elements unite below without the intervention of a median element or sternum, while in the former the sternum or parts of it, are generally present. Either arrangement is susceptible of much mechanical strength, as witness the Siluroid fishes on the one hand, and the mole on the other. The numerous segments of the fishes' pectoral arch must, however, be an element of weakness, so that from a mechanical standpoint it must take the lowest place. The presence of sternal elements, with both clavicle, procoracoid, and coracoid bones on each side, gives the Reptilia the highest place for mechanical strength. The loss of the coracoid seen in the tailed Batrachia, and loss of coracoid and procoracoid in the Mammalia, constitute an element of weakness. The line is not then one of uniform ascent in this respect.

The absence of pelvis or its extremely rudimental condition in fishes, places them at the foot of the line in this respect. The forward extension of the ilium in some Batrachia and in the Mammalia, is to be compared with its backward direction in Reptilia, and its extension both ways in the birds. These conditions are all derived by descent from a strictly intermediate position in the Batrachia and Reptilia of the Permian epoch. The anterior direction must be regarded as having the mechanical advantage over the posterior direction, since it shortens the vertebral column and brings the posterior nearer to the anterior feet. The prevalence of the latter condition in the Mammalia enables them to stand clear of the ground, while the Reptilia move with the abdomen resting upon it. As regards the inferior arches of the pelvis, the Mammalia have the advantage again, in the strong bony median symphysis connecting the ischium and pubis.[1] This character, universal among the land Vertebrata of the Permian epoch, has been lost by the modern ~~Batrachia~~, Reptilia, and birds, and is retained only by the Mammalia. So the line, excepting the Mam-

[1] This is an advantage as a protection during gestation.

malian, have *degenerated* in every direction in the characters of the pelvis.

The limbs of the Pisces are as well adapted to their environment as are those of the land Vertebrata, but from an embryological standpoint, their structure is inferior. The primitive rays are less modified in the fin than in the limb; and limbs themselves display a constantly increasing differentiation of parts, commencing with the Batrachia and ending with the Mammalia. The details of these modifications belong to the history of the contents of the classes however, rather than to the succession of the Vertebrata as a whole.

In review it may be said, that a comparison of the characters which define the classes of the Vertebrates, shows that this branch of the animal kingdom has made with the ages successive steps of progress from lower to higher conditions. This progress has not been without exception, since as regards the construction of the scapular arch, the Mammalia have retrograded from the reptilian standard, as a whole.

In subsequent articles I shall take up the lines of the classes separately.

(*To be continued.*)

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EDITORS' TABLE.

EDITORS: A. S. PACKARD AND E. D. COPE.

——The annual report for 1883–4 of Professor Agassiz to the president and fellows of Harvard College, on the condition of the Museum of Comparative Zoölogy, contains much matter of interest to the naturalist on the subject of the accumulation and care of collections. The director of the museum thinks that it is not advisable to create collections which "must undoubtedly be duplicated in Washington or New York." That portion which relates to the care of the perishable materials contains many suggestive statements. Among these is the information that the large collections of reptiles, fishes, mollusks, Crustacea and echinoderms in alcohol, made by the museum, have become in great degree useless for nice scientific work, and that every year much material has to be thrown away. Such a statement as this must be equally applicable to all museums. That it should be true is greatly to be regretted, and points clearly to the

necessity of using more efficient methods or materials for preservation in future. While in the language of Professor Agassiz, "Undoubtedly many most interesting problems require large collections for their solution, the cost of maintaining" the collections of perishable specimens "may stagger the most enthusiastic collector." "The function of a museum is without doubt to use its resources in the purchase and care of special collections," but at the same time, "with the present facilities and cost of travel it would be far cheaper for an institution to supply the specialist with the necessary funds for such an investigation" (as that of recent fishes). The general result of these somewhat opposing considerations is, that while there is no limit, excepting that of space, to the extent to which collections of imperishable materials can be carried, it is better not to accumulate collections which may be duplicated elsewhere, or large quantities of perishable specimens. For the study of this class of objects the money of institutions is more profitably expended in furnishing specialists with facilities and fresh materials.

It is evident, however, that even historical collections of perishable material must accumulate. It is also true that students must have such collections as the means of obtaining the education necessary as a preliminary to research, and for the purpose of studying the coarser anatomy. Moreover, while distinctness of character should be sought by every museum, it is not certain what material may or may not be duplicated elsewhere, and every important locality should have its reference collection as complete as circumstances permit. How to do this more perfectly and economically is one of the problems of the day.

—— The School of Biology of the University of Pennsylvania has been established, as we understand, for the purpose, first, of sustaining and conducting original research; and second, to furnish incidentally to this leading object instruction to persons desirous of making of research a pursuit. No measures will be spared to carry these intentions into effect. Such an institution has long been needed in Philadelphia, and the reputation of the city as a factor in the scientific growth of the country is much concerned in it. The possibility of realizing this project is almost entirely due to the generosity of Professor Horace Jayne, who has sustained much of the necessary expense of the establishment. The appropriation of money to forward the intellectual

development of a community is one of the most effective ways of elevating it in all respects, as it applies energy to the root of the matter instead of attempting to mend the leaves and fruit. It is a prophylactic, while much of the charity of the world has rather the character of a curative. All students will unite in the hope that Professor Jayne's liberality will meet with the fullest appreciation, and bring him due reward.

—— Communication with our neighboring republic on the south, is now easy. The opening of the Mexican Central Railroad brings the City of Mexico within seven days of the Eastern United States, and it will not be long before through travel to Guatemala by rail will be possible.

Naturalists need not be reminded of the richness of this magnificent country in all that interests and delights them. The region embraced by it and the republics to the south of it, are characterized by the remarkable variety of their animal and vegetable productions, the number of species of animals, at least, being much greater in a given area than in the North American region. The species of the higher classes are being rapidly made known, but the investigation of those forms of life which require to be studied in the country itself, has scarcely commenced. Both inland and on the sea coast a field lies open which will tempt specialists, and some of our schools of biology will doubtless establish laboratories and inaugurate explorations in the near future. The cheap and good living to be had in the country is not the least of the facilities to be found in Mexico.

—— In his attractive article in the *Contemporary Review* entitled Würzburg and Vienna, M. Laveleye writes of Ludwig Noiré's new book, Das Werkzeug (The Tool) which proves the truth of Franklin's saying: "Man is a tool-making creature." Noiré says that the origin of tools dates from the origin of reason and language. He thus accounts for the origin of language. In the beginning, as far back as we can conceive, man was forced to act on matter to obtain food. This action in nature for the purpose of satisfying wants, is labor. As men were living together in families and in tribes, labor was carried on in common. A person making a muscular effort very naturally pronounces certain sounds in connection with the effort he is making. These sounds, repeated and heard by the entire group, were after a time understood to signify the action of which they were the spontaneous accompaniment. "Thus was language born from natural activity in view of supplying imperious needs, and the verb representing the action preceded all their words. The effort to procure the necessary and useful develops the reasoning powers, and tools soon became necessary. Wherever traces of prehistoric men are found, there is also to be found the flint implement. Thus reason, language, labor and implements, all manifestations

of an intelligence capable of progress, appeared almost simultaneously."

In another work, entitled Origin of Speech, Noiré has developed this hypothesis. His book was reviewed by Max Müller, who regarded this view as too exclusive, yet that it was far superior to either the onomatopœia or the interjection theory, and that it was certainly the best and most probable one brought forward at present.

Whether this hypothesis seems plausible or not, would not a comparative study of the physiology of the vocal organs, and of the connection between the brain and the faculty of speech throw light on this problem? May not the power of speech have been a differentiation of the musical power, and have originated from the play of the intenser emotions or passions rather than from the mechanical movements of the arms or legs in labor?

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RECENT LITERATURE.

Third Annual Report of the U. S. Geological Survey.[1]—Succeeding the director's report and those of the chiefs of divisions, are the papers accompanying, and which constitute the main portion of the volume. These are: Birds with teeth, by Professor O. C. Marsh; The copper-bearing rocks of Lake Superior, by R. S. Irving; Sketch of the geological history of Lake Lahontan, by Israel C. Russell; Abstract of the report on the geology of the Eureka district, Nevada, by Arnold Hague; Preliminary paper on the terminal moraine of the second glacial epoch, by T. C. Chamberlain; and a review of the non-marine fossil Mollusca of North America, by C. A. White, M.D.

All of these papers are carefully prepared and elaborately illustrated. In his article on birds with teeth, Professor Marsh concludes that the fact that the three oldest known birds should differ so widely from each other, points unmistakably to a great antiquity for the class. Archæopteryx, Hesperornis and Ichthyornis are all true birds; but the reptilian characters they possess are convergent toward a more generalized type. No Triassic birds are known, and hence we have no light on this stage of the development of the class. They will doubtless be found, however, and if we may judge from Jurassic mammals and reptiles, the next classes above and below birds, the avian forms of that period would still be birds, although with even stronger reptilian features. "For the primal forms of the bird-type, we must evidently look to the Palæozoic; and in the rich land-fauna of our American Permian we may yet hope to find the remains of both birds and mammals."

[1] *Third Annual Report of the U. S. Geological Survey to the Secretary of the Interior, 1881–'82.* By J. W. Powell, Director. Washington, 1883. Royal 8vo, pp. 564.

Professor Marsh then enumerates the characters we should expect to find in the ancestral type of birds, the more essential characters being a free quadrate bone, since this is a universal feature in birds, and only partially retained in the Dinosaurs now known. "The birds would appear to have branched off by a single stem, which gradually lost the reptilian characters as it assumed the ornithic type, and in the existing Ratitæ we have the survivors of this direct line. The lineal descendants of this primal stock doubtless early attained feathers and warm blood, but, as already shown, never acquired the power of flight. The volant birds doubtless separated early from the main avian stem, probably in the Triassic, since, in the formation above, we have Archæopteryx with imperfect powers of flight."

In his sketch of the geological history of Lake Lahontan, Mr. Russell describes the topography of the Quaternary lake of that name which lay in what is now Northwestern Nevada, and is now represented by Pyramid and other lakes in Nevada, and Honey lake in California. This system of great lakes, as it seems to have been, was comparable in number and magnitude with the present lakes of the St. Lawrence basin. "At the time New England and a number of the Northern States were covered with an immense mer-de-glace, and the lofty peaks of the Rocky mountains, the Sierra Nevada and a few of the intermediate ranges gave birth to local glaciers, the ratio of precipitation to evaporation throughout the Greatbasin was so great as to give rise to a great number of lakes, whose combined surface must have formed a large per centage of the total area of the region. Twenty-one of these ancient lakes, of which Lake Bonneville and Lake Lahontan are the mostinteresting, have already been explored in the northern part of the basin, and at least three of some magnitude are known to have existed at the south.

The tufa deposits of the lake basin are designated in the order of their age, lithoid, thinolithic and dendritic; these minerals are well represented in the plates. The tufa domes of Pyramid lake are well depicted in Pl. VII, which, with Pls. VIII and IX, were kindly loaned by the director of the survey. A general idea of the lake beds in the Humboldt valley is conveyed in Pl. IX. From the study of the terraces and tufa deposits of Lake Lahontan, it appears that the lake had two periods of high water, separated by a time when its basin was even more thoroughly desiccated than it is now, and followed by the present period of dryness. When the lake reached its second high-water stage it was inhabited by fresh-water gastropods and bivalves, and it must have attained a certain degree of freshness, but Mr. Russell adds, since modern lakes, such as Pyramid and Walker, with a degree of salinity distinctly perceptible to the taste, are now inhabited by similar gastropods, it is not necessary to assign to Lahontan, at that stage, a high degree of freshness.

Tufa Domes—Shore of Pyramid Lake.

[illegible]

McGill University.

Nearly all the valleys which combine to form the basin of Lake Lahontan are due to profound fractures, the displacements in numerous instances extending 4000 or 5000 feet. These movements are thought to be still in progress, the mountains throughout the Great basin either slowly rising or sinking. "As a matter of observation we find the evidence of recent faulting best defined along the bases of the highest of the ranges, indicating that these owe their distinction to the fact that they are still growing."

An important contribution to glacial geology is Thos. C. Chamberlin's preliminary account of the terminal moraine of the second geological epoch, illustrated by excellent maps and views. This second great terminal moraine marks a general advance of the great ice-sheet at a date considerably later than the stage of greatest glaciation. The great terminal moraines of the first glacial epoch have been traced from Cape Cod to Ohio and Illinois, but in the interior of the continent this "supposed extreme outer moraine has not been traced out." The author believes that the western portion of what was supposed to be the great terminal moraine of the first epoch is, in Michigan, Wisconsin, Minnesota and Iowa, a part of the later moraine.

Hyatt on the genera of fossil Cephalopods.—This is an elaborate discussion of the character and relations of the genera of fossil Cephalopods, the results of many years' patient study. It appears in the Proceedings of the Boston Society of Natural History, and is preliminary to a monograph which will appear in the Memoirs of the Museum of Comparative Zoölogy, at Cambridge, Mass.

Univalve shells, the author remarks, may be generally spoken of as cones, which may be either straight, curved or coiled. The larger number of the more ancient shelled cephalopods are straight cones. The young of nautilian shells are identical with the adults of the curved (arcuate) and coiled (gyroceran) and in different series repeat their forms, sutures, shell markings and the outlines of their whorl in transverse section. "They are in succession first arcuate, then gyroceran, and lastly nautilian or close-coiled. In several series genetic lines of adult forms may be followed, which lead by gradation from arcuate, cyrtoceran forms to close-coiled nautilian shells, the whole showing a connected series of transitions in the form and outline of section, sutures, structure and position of siphon, and shell ornaments and apertures. In some cases these graded series are in accord with the chronological record, the straight appearing first, the arcuate either in company with them or later in time, and the gyroceran and nautilian latest."

The author adds that we cannot of course claim that such perfect evidence has been found even in the larger number of series.

"In some of them, certainly, it is not an over-statement to say that the chronology of the evolution of form, the development of the individual, the gradations in the adults and the general differential characteristics all tell the same story, and are decisive for the opinion that in all the larger series of shell-bearing Cephalopoda, the nautilian shells belong to several distinct series and arose independently from straight cones through the intermedium of a graded series of arcuate and gyroceran or closely coiled forms. The generic terms, Cyrtoceras, Gyroceras and Nautilus are really only descriptive terms for the different stages in the development of an individual, and also the different stages in the development or evolution of the series of adult forms in time. In other words, each of these genera as now used, include representatives of all the different genetic series of Tetrabranchs, which are either young shells in the corresponding stage of growth, or adult shells in the corresponding stage of evolution."

Professor Hyatt maintains that the Nautilini were derived directly and independently from a straight cone, and that this primitive nautiline form was a close ally and ancestor of the straight orthoceran-like Bactrites of the Silurian. "All the remaining ammonoids are more concentrated in development, and skip the orthoceran, cyrtoceran and gyroceran stages of their evolution in time. They are evidently descendants of the close-coiled Nautilinidæ, and the evidence here is very strong that the whole order of Ammonoideaarose from a single organic center of distribution, the Nautilini of the Silurian. The succession in time, the evidence of gradation in structure and the development exactly accord with this statement. Nautilinidæ, Goniatites, Triassic transition forms of Ammonitinæ and the true Ammonites of the Jura form a perfect progessive series."

During the investigation Professor Hyatt has been able to add to the facts he has already brought forward in support of the law of acceleration, though he now prefers to designate it as "the law of concentration of development." All the more generalized or lower types, he says, have a direct mode of development, and the more specialized or complicated progressive types have, when at the acme of their development, a more indirect mode of development." The types which are descended from these last have often a mode of development which in many forms is an apparent return to the direct mode of development again."

It is impossible to farther epitomize this important paper, and we shall look forward with much interest to the complete illustrated memoir.

PARKER'S ZOÖTOMY.[1]—Undoubtedly a knowledge of animal morphology, or what used to be called comparative anatomy, lies at

[1] *A course of Instruction in Zoötomy* (*Vertebrata*). By T. JEFFEREY PARKER. With 74 illustrations. London, Macmillan & Co., 1884. 12mo, pp. 397. $2.25.

Western face of the Moraine near Eagle, Wisconsin.

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the basis of a genuine training in zoölogy, physiology or medicine; no one should undertake to be a systematic zoölogist, a physiologist or embryologist without a thorough knowledge of the anatomy of the leading types of the animal kingdom. The first step the student should take is to become familiar with the anatomy of a polyp, a worm, a mollusk, a crustacean, an insect, as well as a representative of each class of vertebrates. We should, as we are accustomed to with beginners, make this work comparative at the outset. We hear a great deal now-a-days of "animal morphology," we hear less of "comparative anatomy," we prefer the older and less pompous term, as the tendency to extreme specialization even in animal morphology is a dangerous one. Yet it does not appear to be so to the author of the present book. The forms he described are treated as if they were so many separate creations, and this is the only criticism we have to make on a work so carefully prepared and so well proportioned. The book is designed in great part to take the place of a teacher. Now to our mind no teacher who does not in the beginning excite his pupils after dissecting one animal thoroughly to compare it in its leading features with the members of other classes, can successfully teach morphology, whose value as a discipline consists in leading the student to compare as well as observe. A few additional pages of matter would, therefore, we think, have been of decided value in calling the student's attention to and fixing in his memory the facts concerning the resemblances as well as differences in the various types he may dissect. We think this may be done without the pupil's "losing in depth what he gains in breadth."

The list of animals selected and described in this course in zoötomy is as follows: the lamprey, skate, cod, lizard, pigeon and rabbit; if a frog, or better, a salamander, had been added, the list would have been complete, but this point has been covered by the full account of the frog in Huxley and Martin's Biology and Gage's account of the Necturus or mud puppy.

The introduction treats briefly of the tools and methods of preparing the subjects for dissection. The two most important chapters are those on the lamprey and lizard, as the pigeon has already been well described and figured in Rolleston's Forms of Animal Life; and the student can easily get access to accounts of the anatomy of a fish, while the works of Mivart and of Wilder on the cat, would be more useful to the American student than that of the rabbit in this book, however excellent Parker's description may be.

The plan of each chapter or section is excellent, the descriptions are well proportioned, the words to be emphasized are in heavy-faced type, the illustrations are well drawn and engraved, neatly lettered and fully explained. The lamprey is very difficult to dissect, and the species being the same on both continents, this

chapter will be particularly valuable to American students. The illustrations in this chapter are also very useful, the skull, with the "branchial basket" and anterior part of the notochord being shown together, besides cuts of the brain-case from above, a full page cut of the longitudinal section of a female from the left side, showing the organs in place; also a view of the urogenital sinus, with the rectum and part of the left kidney, with three transverse sections, one through the branchial region, another through the abdominal, and the third through the caudal; and finally a dorsal view of the brain.

The skate is a novel subject, and its anatomy is carefully described, the skeleton, venous system, urogenital organs, heart and blood-vessels, and nervous system including several views of the brain as well as the ear, being well illustrated. In like manner is the cod described and figured; this chapter will be useful to the American student; the cod's skull, disarticulated, is well figured and briefly described.

Fifty pages are devoted to the account of the lizard (*Lacerta agilis*), and this will be useful in the hands of the American student if living south of Pennsylvania, as he can readily obtain a Sceloporus or swift for dissection. The wood-cuts in this chapter represent the chondrocranium, the scales on the head of several species of lizards, the chief muscles of the ventral aspect and a general view of the body to show the alimentary, circulatory, respiratory and urogenital organs; the latter organs of each sex are also separately figured, as well as the heart and aortic arches, while the brain in different positions is well drawn and engraved. The remainder of the book, comprising the latter half, is devoted to the pigeon and rabbit.

With such a guide as this, and Rolleston's Forms of Life, Brooks' Invertebrate Anatomy, Huxley and Martin's Elementary Biology, Moale on the Turtle and Pigeon, with Parker and Bettany on the Skull, the beginner in zoötomy has full directions and every incentive to lay broad and deep foundations for a knowledge of comparative anatomy.

SHEPARD'S MINERAL RECORD.[1] — This is a bound series of blanks for the use of beginners in the study of minerals, and is preceded by excellent definitions of terms used in examining the physical characters, and of chemical reactions. The only criticisms we should make is, that reference is not made to the system of crystals or the special form, an important feature of instruction in mineralogy, though room is left blank for these points, which might be inserted by the instructor.

[1] *Systematic Mineral Record,* with a synopsis of terms and chemical reactions used in describing minerals. Prepared for instructors and students in mineralogy. By EDWARD M. SHEPARD, A.M., professor of biology and geology, Drury College, Springfield, Mo. t Adapted to any mineralogy. A. S. Barnes & Co., New York and Chicago. Sm. 4 o, pp. 98.

PLATE IX.

Miami University.

RECENT BOOKS AND PAMPHLETS.

Ingersoll, Ernest.—Country Cousins, short studies in the natural history of the United States. New York, 1884. From the author.

Cope, E. D.—Palæontological Bulletin, No. 39. Phila., 1884.

Clevenger, S. V.—Comparative physiology and psychology. Chicago, Jansen, McClurg & Co., 1885. From the publisher.

Hamlin, A. C.—Leisure hours among the gems. Boston, 1884. From the author.

Struthers, J.—On the bones, articulations and muscles of the rudimentary hind-limb of the Greenland right whale (*Balæna mysticetus*). Ext. Journ. Anat. and Physiol., 1881.

——On hereditary supra-condyloid process in man. Both from the author.

Loew, Oscar, and Bokorny, T.—Die chemische kraftquelle im lebenden protoplasma. Munchen, 1882. From the authors.

Dobson, G. E.—On the unimportance of the presence or absence of the hallux as a generic character in mammalogy.

——On the myology and visceral anatomy of *Capromys melanurus*, with a description of the species. Both from the Proc. Zoöl. Soc. London, 1884.

——On some peculiarities in the geographical distribution and in the habits of certain mammals inhabiting continental and oceanic islands.

——On the comparative variability of bones and muscles. Both read before the Biol. Section Brit. Assoc. Adv. Science, Montreal, 1884. All from the author.

Garrett, P. C.—Second report of the Committee on Lunacy of the Board of Public Charities, Penna., 1884. From the author.

Ennis, J.—Two great works to be done on our sidereal system. Washington, 1884. From the author.

Swan, C. H., Brooks, F., Herschel, C.—Ninth report of the Committee on the Metric System of Weights and Measures. Ext. Jour. Assoc. Eng. Societies, 1884.

Whitley, J. R.—The American Exhibition of the arts, inventions, manufactures, products and resources of the United States of America, London, 1886. From the author.

Lütken, C.—Des Crânes des autres ossements humans de Minas Geraes, decouvert et déterrés par le feu professeur P. W. Lund. From the author.

Reighard, J.—On the anatomy and histology of *Aulophorus vagus*. Ext. Proc. Amer. Acad. Arts and Sciences, 1884. From the author.

Winkler, T. C.—Geschiedenis van den Vleugetvinger overgedrukt vit het Album der Natur. From the author.

——Note sur une espèce de Rhamphorhynchus du Musée Teyler. Ext. Arch. du Mus. Teyler. Ser. II, quatrième partie. From the author.

Ext. United Service Oct. and Nov., 1884.—The late attacks upon the coast and geodetic survey. L. R. Hamersly & Co., 1884. From the publishers.

Gurley, W. F. E.—New Carboniferous fossils. Danville, Ill., 1883. From the author.

Folie, F.—Douze tables pour le calcul des réductions stellaires. Ext. Mem. de la Soc. Roy. des Sciences de Liege, 1883.

James, J. F.—The fucoids of the Cincinnati group. Ext. Jour. Cincin. Soc. Nat. Hist., Oct., 1884. From the author.

Powell, J. W.—Human evolution. Presid. address read before the Anthrop. Soc. of Washington, Nov. 6, 1883.

——Outlines of sociology. Idem, Feb., 1882.

——Outlines of the philosophy of the North American Indians. Read before Amer. Geog. Soc., Dec. 29, 1876.

——Address at inauguration of the Corcoran School of Science and Arts, Washington, D. C., Oct., 1884.

——The philosophic bearings of Darwinism. Read before the Biol. Soc. of Washington, May, 1882.

——Wyandotte government, a short study of tribal society. Read before sub-section anthropology. Amer. Assoc. Adv. Sci., Boston, 1880.

——Mythologic society. Read before Amer. Assoc. Adv. Science, Saratoga, Aug., 1879.

——The three methods of evolution. Presid. address before Philos. Soc. of Washington, Dec. 3, 1883.

Albrecht, P.—Sur les elements morphologiques du manubrium du sternum chez les mammifères.

——Erwiderung auf Herrn. Prof. Dr. Hermann v. Meyer's Aufsatz "Der Zwischen kiefer knocken und seine Beziehungen zur Hasenscharte und zur schrägen Gesichtsspalte."

——Ueber die Zahl der Zahne bei den Hasenscharten Kieferspalten.

——Ueber die morphologische Bedeutung der Kiefer-Lippen und Gesichtsspalten.

——Sur les Homodynamies que existent entre la main et le pied des mammifères. All from the author.

Lewis, H. C.—On supposed glaciation in Pennsylvania south of the terminal moraine. Ext. Amer. Jour. of Science, 1884. From the author.

True, F. W.—Suggestions to the keepers of the U. S. life-saving stations, lighthouses and light-ships relative to the best means of collecting and preserving specimens of whales and porpoises. From the author.

Richardson, Clifford.—An investigation of the composition of American wheat and corn. Dep. of Agriculture. Bulletin No. 4. From the author.

Wiley, H. W.—The Northern sugar industry during the season of 1883. Dep. of Agriculture. Bulletin No. 3. From the author.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AMERICA.—*The Chilian Andes.*—The account sent by Dr. Paul Gussfeldt to the Berlin Academy of Sciences, of his recent journey in the Central Chilian Argentine Andes, contains so much that is new and strange that the American reader is led to wish that this continent could be made the scene of more thorough geographical exploration than has yet been accorded to it. It appears that the lofty mountain region containing Aconcagua, the loftiest known point in America, consists of a double range, separated, not by a wide basin or a well-defined valley, but by a trough-like depression, divided by cross ridges. The western chain is the true water-parting, and thus the eastern is broken through in many places by the water rising in the great trough between the two chains. This trough is about 185 miles long, is entirely uninhabited, and has a mean elevation of 9800 feet. The chief valleys of this region are called "cajones," or boxes, because of their straight walls of rock enclosing them. These valley sides are formed of boulder slopes and wall-like outcropping rock, and each has its separate vegetation-zone, limited by perpetual ice. The belts of vegetation, owing to the varied local influences, are of very irregular distribution, and for

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

the same reason the snow limit is not fixed. The diversity and richness of tint of soil and rock are material points in the landscape. The passes over these ranges reach heights of 11,394, 11,696, 12,270, 12,303, 13,474, and 13,779 feet. The highest elevations are on lateral spurs of the chief western chain, near Valle Hermoso, at the commencement of which rises the great volcano Aconcagua, 22,867 feet high.

The structure of the range, together with the wind, are unfavorable for the collection of large glacier-forming deposits of snow. The snow line is often broken by abrupt ice-streams wedged between masses of rock, but these glaciers end far above the valley bottom. The largest glacier found was at the head of a side-valley of the Cachapual, called the Cajon de los Cipreses. On this is an ice-fall 8530 feet long, with an average slope of 22° 15′. There is the evidence of glacier marks that the glaciation once reached a lower level than now (6299 feet); and Dr. Gussfeldt's companion pointed out a conspicuous red boulder, more than a mile away, as marking the point reached by the ice thirty years ago. On account of the abrupt crags, the high peaks seldom show a continuous snow-cap. The parallel ridges of snow caused by strong winds, melt under the fierce sun into forms which often simulate human figures, and are called "Penitentes." These are most abundant between 11,483 and 13,779 feet. The mean height of the snow line between 32° and 33° S. lat. is estimated at 13,779 feet, diminishing to 11,483 at 34° S. lat. Between the western cordillera and the Pacific there is an out-lying coast range. Dr. Gussfeldt and his assistant reached 21,030 feet on Aconcagua, and, though exhausted by the effort of speaking, had no flow of blood from mouth or nose.

The Supposed New Island off Iceland.—The supposed new island off Reykjanes, Iceland, turns out to be a myth. The French war-vessel *Romanche* and the Danish *Fylla* have carefully examined the locality without finding any new land. In the opinion of Capt. Normann, of the *Fylla*, one of the well-known Fowlskerries, either Geirfugladraugr or Grenadeerhuen, has figured as a new island. Possibly an abnormally clear day caused the lighthouse-keeper to, for the first time, perceive an object which he has since continued to see simply through knowing where to look for it.

Meade river.—Lieut. P. H. Ray has made an exploration southward from Point Barrow along the Meade river, which he struck sixty milesfrom its mouth, and followed for 100 miles, until he came in sight of a low range of mountains trending north-west and south-east, dividing the north-east water-shed from that of Kotzebue sound. The guides, fearful of imaginary enemies, refused to go further. The region is uninhabited, and is visited only by a few natives from Hornook and Ooglamie in pursuit of reindeer. There is no timber; a few Arctic willows on the river and

some coarse grass on the hummocks and along the seashore, and a dense growth of moss is all the vegetation. Lieut. Ray is satisfied that there is no open Polar sea from the fact that the temperature of the water does not alter between October and July, as it must do if a large body of warmer water existed round the pole.

Lake Mistassini.—Little that is definite appears to be as yet known respecting the actual dimensions of Lake Mistassini and other bodies of water reported to exist in the north-eastern part of the Province of Quebec and in Labrador. A French missionary, writing in 1672, says that Lake Mistassini is "believed to be so large that it took twenty days to walk around it." Mr. Burgess affirms that it is 150 miles in length, and abounds in deep bogs. An old trader of the "Compagnie des Postes du Roi," who was stationed on it for several years, estimated its least width at ninety miles. The account of 1672 mentions another lake "ten days round, and surrounded by lofty mountains." These lakesappear to occupy a depression similar to that occupied by Lakes St. John, Temiscaming, and many smaller lakes to the south ward, and Silurian limestone has been observed on Lake Mistassini as well as at Lake St. John. The former lake is supposed to be about 1300 feet above the sea, and the land between it and Lake St. John to the south of it, does not rise above 1500 feet, while Lake St. John is only 300 feet above the sea. The plain around Lake Mistassini is said to be very fertile. and attention has recently been called to the magnificent forests and fertile soil of the country around Hudson's bay, to the north of it. Three expeditions have been dispatched during the past summer to explore the lake region; one by way of Lake St. John, another by the River Betsiamits, and a third from Newfoundland. The last expedition has orders to land scientific observers at various points upon the coast of Labrador, where they will spend the winter. The vast plain stretching north and west of Lake St. John has a clayey soil of great fertility, and a climate equal to that of Montreal. Thousands of settlers are already there, and the dense forest is disappearing. The explorations in progress will doubtless open up extensive areas for colonization, besides adding largely to our geographical knowledge.

American Notes.—The articles found by an Eskimo upon a floe in Julianshaab bay appear to have been those left on the occasion when, according to the report of Messrs. Danenhower and Melville, the escaping crew of the *Jeanette* camped for a few days on some ice-floes. Among them are the lower part of a tent, the sides of a wooden chest, with some words in pencil written upon them, a bill of lading, a torn book of cheques, a pair of oil-skin trousers marked "Louis Noros," and a bear skin. The ice-floe must have drifted about 2500 miles, and as this occupied

about 1000 days, we have an average rate of drifting of two and a half nautical miles per day.——M. Thonar will undertake an expedition to investigate the delta of Pilcomayo, and endeavor to open up a great trade route between Bolivia and Paraguay. In this it is said that he will receive the active support of several South American governments.——Drs. Clauss and Herr von der Steinen have returned to Para from a successful investigation of the tributaries on the upper right bank of the Amazon and Xingu rivers.

Africa.—*Mr. O'Neill's Journey.*—Mr. H. E. O'Neill, in his account of his journey from Mozambique to Lakes Shirwa and Amaramba, through the Makua and Lomwe countries, states that in point of geographical interest, of security, and of facility of travel, this route compares favorably with any overland route to the African lakes. The Zanzibar-Tanganyika route is occupied by lawless chiefs, who levy extortionate black-mail, the route from North Nyassa to Zanzibar has been shown by the expedition of Capt. Elton to be one of great difficulty, and the old Kilwa-Nyassa route, opened up by Dr. Livingstone, now passes in great part through a deserted and desolate country, owing to the ravages of the Magwangwara, the same tribe which blocks the North Nyassa route. Native rule among the Makua consists of a confederation of petty chiefs, each of which is perfectly independent with regard to the internal affairs of his own state. The Makua can weave cloth, but wear so little that a palm's breadth, forty inches long, would provide clothing for half a dozen men or women. Namuli peak and its surrounding hills, 8500 to 9000 feet high, forms one of the most striking features of the country. A feeling of great reverence for particularly conspicuous hills, reaching almost to mountain-worship in the case of Namuli, exists among the Lomwe. The feeling probably arises from the fact that each of these elevations has served as a refuge to the people living near it when attacked by their enemies.

The Kwilu Expedition.—In human suffering and cost of life the expedition sent to H. M. Stanley, in 1882, to explore the Kwilu-Niadi valley, rivals that of Lieut. Greely to the Arctic. The party, consisting of seven Europeans and seventy Zanzibaris, got into difficulties from want of food at the start. Two Europeans were left behind at Isanghila, where one died. The accidental discharge of the rifle of a Zanzibari, soon after, nearly brought on a conflict with the natives. Two magnificent ranges of hills were then met with, separated by a lovely valley, watered by the Ludima, a tributary of the Niadi, which was found to be identical with the Kwilu. The first station of the association, Stephanieville, was founded near the junction of the Ludima with the Niadi. All the white men, except the leader, Capt. A. G. Elliott, were now disabled. Each of the two Belgian officers,

MM. Destrain and Legat, were left in charge of a station, yet Capt. Elliott pushed on, with Von Schaumann, hopelessly ill, lashed to a mule, and the only remaining officer in a deathly stupor from sun-stroke. Some time before this, a portion of the Zanzibaris mutinied, fourteen deserting, and part of the baggage had to be destroyed for want of bearers. Covered with painful ulcers, emaciated, and with bleeding feet, Capt. Elliott, when on the point of succumbing, was met by a native sent to his assistance by M. Van de Velde, who had been sent by Stanley to his assistance, and was at Kilabi, seven days off. Eventually Capt. Elliott and his two companions reached the coast, but Von Schauman died on the voyage home. In three and a half months only 600 miles had been traversed. Capt. Elliott subsequently explored the Kwliu river and valley in company with Mr. Spencer-Burns and MM. Mikie and Destrain. The district has for the most part been freely ceded by the natives to the association, and formed into a province with fifteen stations. Capt. Elliott is administrator, with a staff of twenty-eight officers and about 250 men.

African Notes.—Sr. Bianchi has successfully finished a journey from the eastern boundaries of Abyssinia along the River Golima to the Italian possession of Assab.——Lieut. Shufeldt, U. S. N., has recently traveled across Madagascar south-west from Antananarivo. He thoroughly investigated and mapped the head-waters of the Zizibongy and its tributaries, and reached the coast on July 2d, after a journey of 680 miles. Then crossing the Mozambique channel in an old boat, he landed at Mozambique.——Lieut. Becker will be despatched by the African International Association to cross Africa and connect Karema, on Lake Tanganyika, with Stanley's stations of the Upper Congo.——Herr R. Flegel has returned to Berlin. During the last two years he has explored all Adamawa, and discovered the course of the Binué, but the feuds and violence of the intervening tribes prevented him from journeying from the Binué to the Congo. His conviction is that the Binué is navigable for 1100 kilometers, and its chief affluents, as for instance the Taraba, for a distance of fifty to sixty nautical miles, during five or six months of the year.

South Georgia.—Though in 54° 31′ S. lat., this island is by its climate antarctic. Royal bay is surrounded with enormous glaciers 900 to 1200 feet in height, rising inland to 6000 or 7000 feet. The mean temperature, during the year, from Sept., 1882, to Sept., 1883, was found by Dr. Schrader to be 35° F.; in February, the warmest month, it was 42°, in June, the coldest, 26° 6.′ The fauna and flora are meager, although the mosses are fine.

GEOLOGY AND PALÆONTOLOGY.

THE WHITE RIVER BEDS OF SWIFT CURRENT RIVER, NORTH-WEST TERRITORY.—Dr. Geo. M. Dawson, of the Geological Survey of the Dominion of Canada, Dr. Alfred Selwyn, director, has sent me for identification a number of fragments of mammalian skeletons from the above locality for determination. They embrace ten species, which are the following: Rodentia, *Palæolagus turgidus* Cope; Creodonta, *Hemipsalodon grandis*, gen. et sp. nov.; Perissodactyla, *Menodus* sp., *Menodus* sp., *Anchitherium* sp. indet., *Aceratherium mite* Cope, *Aceratherium pumilum* sp. nov.; Artiodactyla, *Entelodon mortoni* Leidy, ? *Leptomeryx mammifer* sp. nov.; Carnivora, ? *Dinictis* sp.

Of the above the most remarkable is the Creodont, *Hemipsalodon grandis*. The new genus belongs to the Oxyænidæ,[1] and is the first one of that family that has been found in beds higher than the Bridger Eocene. The species is the largest of the Creodonta, and the jaw from which it is known is more robust than that of any existing carnivore. Its dimensions are about those of the *Achænodon insolens* of the Bridger beds. The genus Hemipsalodon differs from the others of the family in the presence in the lower jaw of the full dental series of four premolars and three true molars without diastema behind the canine. Incisors three. The only crown perfectly preserved is the last true molar. It is of the type of Oxyæna, but probably has no internal tubercle (specimen worn at the point). It has a heel more or less cutting. The species is characterized by the deep compressed form of the ramus, and the long symphysis. The incisor teeth are crowded, and the canine tooth is of enormous size, and is directed upwards. The premolars are all two-rooted, except the first. The fourth is longer than the first true molar. The true molars increase in size posteriorly. The third is very robust, and has elevated cusps, the median exceeding the anterior. The sectorial edges are very steep, forming together a V. The heel is quite short, and has a cutting keel which is the summit of the external face, and is nearly median. The coronoid process rises at a very short distance posterior to it. The masseteric fossa does not extend downwards to the inferior edge of the ramus. The latter is not inflected on the inner side as far posterior as below the middle of the coronoid process, where it is broken off.

Length of dental series, M. .212; of true molars .085; of premolars .108; diameters of last true molar: anteroposterior .034, transverse .021; do. of canine at base: anteroposterior .040, transverse .029. Depth of ramus at M.3, .086; length of symphysis .131.—*E. D. Cope.*

OCCURRENCE OF BOULDERS OF DECOMPOSITION AT WASHINGTON, D. C., AND ELSEWHERE.—In the literature of surface geology surprisingly little is said of "boulders of decomposition." This

[1] See NATURALIST, 1884, p. 480.

probably arises from the fact that such are seldom seen *in situ* north of the southern limit of the drift, having been removed from their places of origin during the ice age. It may not be uninteresting to those geologists whose studies are in the field of surface deposits to know of a convenient locality where such boulders are even in the process of being made, as doubtless very many of the erratics, especially those of larger size, were thus produced before their subsequent transportation, as pointed out by Dr. Sterry Hunt and others.

At several localities in the District of Columbia, boulders of various sizes can be seen, which to the superficial observer may be taken for drift masses, as in my own case upon earlier visits to the region. During June, 1884, whilst driving with Mr. W. J. McGee (U. S. Geol. Surv.) past a hillside just outside of Georgetown, along the Potomac river, I observed perfectly rounded boulders of gneiss in a large mass of decayed rock of similar composition. Subsequently, accompanied by Mr. George P. Merrill (National Museum), we more thoroughly examined them. The hillside has been partly cut away in the construction of the road beside the river, and thus the decayed crystalline rocks are exposed for a depth of forty or fifty feet or more. Much of the gneiss rock is disintegrated, but contains unaltered masses which have resisted the atmospheric decay. The rock is often poor in feldspar. In some places it is hornblendic. Some of the gneiss upon weathering exhibits a schistose structure, yet much is remarkably compact, but traversed by numerous jointed planes, extending in all directions. As the weathering proceeds from the jointed planes it leaves solid masses of every possible shape, from those with only the more exposed upper solid angles rounded off, through various forms where all the angles are removed, but with flat sides remaining, representing the original joint planes, to masses which are almost perfectly spheroidal, though often showing a banded structure. Internally some of the smaller boulders are more or less decayed, others are perfectly compact, but in digging them out there may be seen surrounding them concentric zones, marking not concretionary structure but the progress of decay. These coatings may be removed like the coats of an onion. Each zone is defined more or less sharply, sometimes with comparatively little gradation from the last decomposed layer to the resulting solid interior which forms the boulder.

Upon the sloping top of the hills there are large sized boulders; with their angles and faces more or less rounded, and although standing two, three or four feet above the grass-covered soil of decomposed gneiss, yet their under portions, upon examination, are found to be connected with the solid masses beneath. Thus we find in every stage of production excellent examples of the genesis of large "boulders of decomposition"—boulders not distinguishable from very many of those which have been trans-

ported great distances during the Pleistocene period. There are several localities in the District of Columbia where such boulders may be seen, but their development cannot be studied so well as in the artificial cuttings in the hillsides along the Potomac river.

Having made a study of these large boulders in a state of formation, one, who is familiar with Northern erratics, is led to agree with Dr. Sterry Hunt, that at least the larger "rounded masses of crystalline rocks, left in the process of decay, constitute the boulders of the drift," and not only these but many *roches moutonnées.*

This deduction has been objected to upon the ground that boulders generally do not continue to enfoliate.

In the District of Columbia many of the boulders seen out of the hillsides described, do not show continued exfoliation (naturally very slow and with the atmospheric forces removing such as rapidly as formed, where not protected) any more than many erratics, while others are more or less uniformly decayed throughout the whole mass.

Although very many erratics do not show regular exfoliation, yet there are numbers of places where exfoliating boulders may be found in the drift. Perhaps there are no better localities for studying these rocks than those I examined during the last two summers, in the greater drift deposits along the Mississippi river, at Burlington, Keokuk, Warsaw and elsewhere. At these places numerous northern boulders—mostly greenstones—may be found of various sizes from a few pounds to a few thousand, which are now exfoliating and in various stages of decay, having forms from subangular to spheroidal. Also near the southern limit of the drift, at Columbia, Mo., situated upon the highlands, away from the river valleys, similar examples may be found, both of greenstone and gneissoid rocks.

Neither the presence nor absence of ice scratches affect the above explanation of the primary origin of these large boulders, but only represent subsequent abrasion, or the absence of that action, or else the more recent surface decay of the rocks themselves.—*J. W. Spencer, M.A., Ph.D., F.G.S.*

ARE THERE ANY FOSSIL ALGÆ?—Mr. Lester F. Ward, in a paper read before the American Association at Philadelphia gave some statistics of the fossil flora of the globe. Among other things he said that from the Lower Silurian there have been described species of Algæ. The question arises, what are the probabilities of Algæ being preserved in a fossil state?

It seems to have been the habit of geologists, almost from the time that palæontology assumed the aspect of a science, to refer to "fucoids" or Algæ many fossil markings which were evidently not *animal* remains. It was assumed that everything fossil must have been an organism, and it is only of late years

that the fact has been admitted that many of these fucoids are in reality inorganic.

Let any one consider for a moment the structure of the most of the species of modern Algæ; remember how easy it is for cellular tissue to be destroyed by only a short immersion in water, and the unreasonableness of expecting to find fossil Algæ will be perceived. Or again, let anyone turn, as Professor Lesquereux, for one, has done, to modern sea beaches; let him see the immense masses of kelp thrown up by the waves of every storm, and see how soon they disappear by passing "into gelatinous, half-fluid matter, which penetrates the sand" (Lesq.), and he will again see how unreasonable it is to say Algæ can be long preserved. Even when covered with sand, mud or clay they disappear and leave no trace behind them.

Professor Hall, in the first two volumes of the Palæontology of New York, enumerates thirty-six species and varieties of these fucoids from the Trenton, Hudson River and Clinton groups. He recognizes the fact that many trails, burrows and possible water marks are preserved in the rocks, but has no hesitation in referring many fossil marks to undoubted Algæ. Later writers have not been behind in naming and describing other species. In 1878 fourteen new ones were added as found in the rocks of the Cincinnati group. Recent investigations of these fourteen, and of some eighteen others reported from this group, have revealed the fact that *not a single one* is an undoubted Algæ, *all* can be referred either to water marks, trails, tracks or burrows of different sorts, or to graptolites.

This statement can be proved only by comparison with marks found on recent beaches and mud flats. Sir Charles Lyell has shown how leaves, impressions of bird tracks, mud cracks, worm borings and rain-drop impressions can be and are preserved on the mud flats of the Bay of Fundy. There is no reason for supposing that circumstances were less favorable during the continuance of the Silurian epoch in geological time. The writer of this has studied many recent mud marks, and has seen in process of formation tracks and burrows which resemble, to an astonishing degree these fossil marks.

For instance, the burrows made by a species of beetle in the mud wonderfully resemble some of the fossils, *Palæophycus rugosus*, for example. The trickling of water down a sloping bank leaves traces like those which, fossil, have been called Algæ. The dashing of rain on the surface of mud leaves marks which have been compared to the roots of plants. Impressions left on mud by fragments of organisms have been described as fossil Algæ, even when not the remotest resemblance could be noted between them and any modern prototype.

Professor Nathorst, in a memoir written in Swedish[1] and pub-

[1] Om spar af nagra Evertebrerade djur M. M. ochderas Paleontologsika Betydelse.

lished in Stockholm in 1881, enters a vigorous protest against the indiscriminate identification of fossil marks with Algæ. In this memoir he tells how certain of these marks were readily made by himself, and how many others can be identified with marks seen on ocean beaches.[1] It is, indeed, time that this habit of referring to some sort of life every mark found in the rocks of the earth, and calling all uncertain marks marine plants, should be protested against. If it is not done the nomenclature of the science will be so encumbered with useless names that chaos will result. The multiplication of species has gone entirely too far already; and when every mark made by a dash of water, every turn made by a worm or shell, and every print left by the claw of a crustacean is described as a new addition to science, it is time to call a halt and eliminate some of the old before making any more new species.—*Jos. F. James.*

GEOLOGICAL NEWS.—*Jurassic.*—The Marquis of Saporta announced to the geological section of the French Association for the Advancement of Science, the discovery of a plant bed of Jurassic age near Beaune. The enclosing rock is a fine-grained limestone, probably of the Corallian epoch. The plants are closely related to those which have been collected from beds of the same age upon the Meuse, and consist of attenuated conifers and dwarf cycads and ferns. The discovery at two points so far apart of such a starveling flora proves that it was not local, as at first believed, but was spread over a large area. Associated with these plants are some widely-spread echini, such as *Cidaris cervicalis*, *C. florigemma*, etc. M. Saporta has also returned to the defense of bilobites, gyrolites and other fossils, the vegetable origin of which has recently been disputed.——The Cretaceous of the Pyrenees has been studied by M. Hebert, who published the first part of his researches in 1867, and in a more recent article states that nothing has since come to hand to invalidate his previous conclusions respecting the Lower Cretaceous, which are to the effect that the Lower Neocomian is wanting, the Middle Neocomian is continuous, the Upper Neocomian occurs at many points, and is lacking in others through denudation, and that the Gault exists both in the Central Pyrenees and the Corbières. The Lower Cretaceous usually abuts upon faults which bring it in contact with beds which are proved by their fauna to be Senonian, and therefore much more recent. The Lower Cenomanian appears to be absent from this region, while the Upper Cenomanian lies either upon the Neocomian or the Trias, thus showing that at the time when the chalk of Rouen was deposited the Pyrenees had in great part emerged, forming an island or a series of islets in a Cenomanian sea. The Turonian is largely represented in the Pyrenees, but the almost crystalline structure of the beds is unfavorable to palæontological researches.

[1] The Count Saporta has shown, in reply to Mr. Nathorst, that some of the reported Algæ are correctly so determined.—ED.

Tertiary.—Sr. Lotti (Boll. Com. Geol. d'Italia, 1884) gives a summary of his investigations into the age and structure of the granites of Elba and the surrounding districts. These granites show two principal types, granite and quartzose porphyry; the latter traverses and is involved with the sedimentary rocks of the Apennines in such a way that geologists have been compelled to pronounce it Eocene. As it is against the usual idea to refer granites to so recent an epoch, an effort has been made to find a separation between the granite and the quartzose porphyry into which it passes. This Sr. Lotti declares to be thoroughly inadmissible, and at direct issue with the facts. The feldspathic rocks graduate from a normal or tourmaliferous granite to a quartzose porphyry through varieties with or without tourmaline, but the Pre-silurian gneissic schists of the eastern part of the Elba show a gradual passage toward granite, and are traversed by granite seams. Sr. Lotti concludes that not only are the porphyry, granite and intermediate varieties of the same age, but that all were formed at the expense of the gneissic schists in the Eocene epoch, while the Eocene strata were contorted and dislocated, and fragments embedded in the erupted mass.

Quaternary.—M. A. Favre has presented the Paris Academy of Sciences with a map of the ancient glaciers of the northern slope of the Swiss Alps and of the chain of Mt. Blanc. This map indicates the development of the glaciers, and, so far as the scale permits, shows also the glacial deposits, erratic blocks, and moraines. Besides showing the direction and extension of the seven principal glaciers, M. Favre demonstrates how, on taking the height of an erratic block above the neighboring valley, it is possible to know what was formerly the thickness of the ice over that point, and also how the slope of the surface of the ancient glacier can be determined. In this way he has determined thicknesses of 1181, 1220 and 1235 meters. The author particularly insists upon the extension of the glacier of the Rhone, which at certain points reaches a height of 1650 meters, and for a length of 149 kilometers and a width of 45 was almost horizontal. The moraines of these old glaciers are numerous. Many are composed of clayey or marly deposits with striated pebbles and blocks of greater or less size, while others are almost entirely formed of blocks of crystalline rocks. Examples of the latter occur at Combloux and Césarege, in the valleys of the Arve, Rhone, etc. Here are blocks which contain from 700 to even 2000 cubic meters.

BOTANY.[1]

THE FERTILIZATION OF PHYSOSTEGIA VIRGINIANA.—In marked contrast with the imperfectly proterandrous almost synacmic *Brunella vulgaris* is the closely related Physostegia. The pro-

[1] Edited by PROF. C. E. BESSEY, Lincoln, Nebraska.

terandry and movements of filaments and styles are here decided. On the opening of the bud the almost equal anthers converge and place themselves in line across the throat of the flower. The stamens curve forward so as to come into more ready contact with the body of the visiting bee (Fig. 1), while the style is curved backward and lies under the upper lip of the corolla. When the stamens become effete the pairs on either side diverge (Fig. 2) and bend back, stationing themselves under the upper lip while the style moves forwards, takes the place of the effete stamens and opens its bilobed stigma (Fig. 3). Such is the proterandry of this flower which, as most of its allies, requires the visits of bees for its fertilization.

The flower is of a pale rose color, which is deeper on the upper lip. The upper and lower lips are spotted with purple, while the

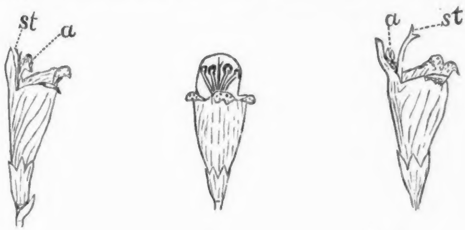


Fig. 1. Fig. 2. Fig. 3.

Physostegia virginiana. FIG. 1.—Male state. Fig. 2.—Stamens curved back. FIG. 3.—Female state; *a*, anthers; *st*, stigmas.

interior of the inflated corolla is striped with the same color, the lines leading downwards and backwards towards the stamens, the filaments serving as guides to the honey, which lies in a tube formed by the contraction of the corolla along the line of the outer set of filaments. In this way two tubes are formed, an upper and larger one, which is convenient for the bees, and a lower contracted one which appears more accessible at first sight, but contracts below, so as to doom to disappointment the mistaken insect. The lines of purple lead to the true entrance. In this species, as in the Brunella, the honey gland seems to be a body of greenish-yellow color, occupying the place of a fifth nutlet supposing that the flower contained that many.— *Aug. F. Foerste, Granville, Ohio.*

BEGINNING BOTANY.—In teaching botany during the past twelve or fifteen years, I have generally set students at work for several weeks, in the beginning, with specimens only. These are given each member, and he is required to investigate and report at the meeting of the class. Some of these reports are made in writing. More or less of this work is done throughout the course. It has proved very satisfactory to pupil and teacher.

In March, before the opening of vegetation, the last class of freshmen began with the study of young branches of numerous kinds of deciduous and evergreen trees and shrubs. I send you the notes of W. F. Hoyt, one member of the class. I do not know that they are any better than many others which were presented:

"A comparison of the leaves, buds and young branches of the Scotch pine with those of the Austrian pine.

"To a casual observer there is little difference between these two pines, but on close inspection it will be noticed that the Austrian bears a medium-sized cone, while the Scotch has a very small one, grown sparingly. [It was not intended to study cones at this time.]

"Again, the leaves of the Austrian pine are from five to five and a-half inches long. They are thick and stiff, while those of the Scotch pine are from two to three and a-half inches long, and are quite slender and limber. In both the leaves have the same shape; in both the leaves are in pairs, and when placed together make a long round body. The covering of the lower part of the leaves extends much farther up on the Austrian, and is of a much darker color than on the Scotch pine. The leaves of the Scotch pine are lighter in color; the tree and branches more slender.

"The outer bark of the Austrian is thicker and darker, and the primary leaf scales shows very plainly. The leaf scales do not show plainly in the Scotch pine. Both have three layers of bark, the outer being tough and thin, the next dark-green and spongy, the inner white; in the Austrian quite tender; in the Scotch tougher and more compact.

"As a general rule the Scotch pine sends out five branches in a whorl, while the Austrian pines show no such regularity in this respect. On cutting the limb the Scotch pine discharges more pitch than is discharged by the Austrian pine. The wood of the Scotch pine is a little lighter in color, the rings more plainly marked and the pith a little larger."

In a comparison of the twigs of butternut with those of the pepperidge, A. E. Hager observed, among other things, that the pith of pepperidge contained numerous hard transparent partitions. Our text-books all tell us of the cavities in the pith of butternut.

Work done later in the course was better done.—*W. J. Beal. Lansing, Mich.*

THE STUDY OF PARASITIC FUNGI.—One of the hopeful signs of the times, so far as botany is concerned, is the increasing interest taken in the study of the lower plants in this country. The Fungi and the minute forms of Algæ have been too long neglected excepting by a few lonely specialists here and there who quietly worked away, while almost entirely ignored by the mass of botanists and collectors. Now, however, the eyes of collectors,

while not less open to the higher plants, are learning to look for plants of all kinds, from the simplest protophytes to the most conspicuous of phanerogams. We may hope some day to see a manual of botany which will include within its covers descriptions of all the species of the region it covers.

The Preliminary List of the Parasitic Fungi of Wisconsin, by Professor Trelease, must prove a considerable aid and strong incentive to the collection of Fungi in Wisconsin. About 270 species are recorded, a large list when we remember that it is confined to the parasitic forms only. Most of the species were collected about Madison by the author, and all, with but "one or two exceptions," are preserved as herbarium specimens. Throughout the list hosts and localities are given, and in many cases these are accompanied by valuable critical notes, indicating thorough and careful work.

The Peronosporeæ of the list number twenty-five species, of which four belong to the genus Cystopus, one to Phytophthora and twenty to Peronospora. The Perisporiaceæ number twenty species, the Uredineæ sixty-five (not counting isolated Uredo and æcidial forms, seven of the former and twenty-seven of the latter) and the Ustilagineæ twenty-two species.—*C. E. Bessey.*

Variation in Cultivated Plants.—If seed of the various sorts of the cabbage family be planted alongside each other, a resemblance is observed between all the seedlings at a certain date; it is only as growth proceeds that the development begins to differentiate differences. It seems probable, through a study of the law of breeding, that the period of divergence marks the period at which original selection commenced in order to obtain our present forms. If this observation be substantiated, then by careful study of seedling development we shall be able to determine points of departure at which human guidance shall be enabled to direct in line with the tendencies of the plant. This study of plant growth after the method used in zoölogy, the study of embryology so to speak, not the term "embryology" as applied to nature's plant but that of man's plant, the period between the seed and the differentiation from the natural type, offers much promise of good results, and it seems quite probable that as we attempt to influence the development of the plant before or at the time of the differentiation into the acquired properties of the mature plant we can initiate a new series of selections in certain varieties whose root, bulb, stem and foliage finds use.—*E. L. Sturtevant in 2d Ann. Rept. N. Y. Agrl. Expr. Station.*

Botanical Notes. — The post-graduate course of study in botany offered by Syracuse University is significant of changed notions as to what advanced work in botany consists of. The course is two years in length and includes vegetable histology, physiology, the study of phanerogams, pteridophytes, mosses,

liverworts, lichens, algæ and fungi. Collections are required in each group, thus insuring a practical acquaintance with the plants in their native habitats.——In the first annual report of the Wisconsin Agricultural Experiment Station, Professor Trelease gives accurate popular descriptions of the onion mold (*Peronospora schleideniana* D. By.) and the apple scab and leaf blight (*Fusicladium dendriticum* Wallroth). Both articles are illustrated by wood-cuts, which add materially to their value. Work of this kind is, in our opinion, much more valuable than that which usually fills the reports of these stations. We wish we could see more papers like Professor Trelease's. May we not commend to the directors of agricultural stations the remark of the editor of *Science* in a recent number of that journal, in discussing the proper aim and scope of such stations: "The great need of agriculture to-day is not new varieties of plants or improved breeds of animals, new methods of cultivating the soil or improved systems of farming; all these, and many other like things, are good; but the two great wants are a better knowledge of principles and greater intelligence to apply them."——Dr. B. D. Halsted, of New York, has been elected to the chair of botany in the Iowa Agricultural College.——The December *Journal of Botany* contains a fine photograph of the late George Bentham.——We see it announced in English journals that translations of De Candolle's Origin of Cultivated Plants, and De Bary's Anatomy of the Vegetative Organs of the Phanerogams and Ferns have recently been brought out, the former by C. Keagan Paul, London, and the latter by the Clarendon Press, Oxford. ——De Bary's "Vergleichende Morphologie und Biologie der Pilze, Mycetozoen und Bacterien has just reached us, but too late for further notice at this time. It is a stout volume of 558 octavo pages and is illustrated with 198 wood-cuts. This work merits an early translation.——*The Journal of Mycology*, by J. B. Ellis and W. A. Kellerman is announced to appear soon.

ENTOMOLOGY.

EMBRYOLOGY OF APHIDES.[1]—Witlaczil corrects many misconceptions and adds largely to our knowledge of insect embryology. His researches were chiefly on the viviparous females. The oviparous females and the males appear late in season, and have much the same course of development as is here described. The winter-eggs are specially characterized by a large amount of yolk.

1. *The Egg.*—The egg has a peripheral part consisting of clear protoplasm, and a central part consisting chiefly of granulated yolk. The germinal vesicle with nucleus is in the central part, and is capable of amœboid movements. The anterior and poste-

[1] By Dr. Emanuel Witlaczil, of Vienna (Zeitschrift f. Wiss. Zool., Bd. XL, 1884, p. 559–696, and taf. XXVIII–XXXIV).

rior poles of the egg are determined by its position in the ovarian tubule, in which it remains during its whole course of development.

2. *Segmentation and formation of Blastoderm.*—The segmentation instead of being superficial, as usually described, is *endovitelline.* The germinal sac dissolves, and its nucleus divides repeatedly, forming a large number of nuclei within the yolk. The nuclei have amœboid movements, and go towards the posterior pole (*PP*),[1] and thence spread over the surface-protoplasm. A few of the nuclei remain in the center; but the great majority become distributed over the surface, where each forms a center of attraction for the protoplasm. Thus a layer of cells is formed over the whole surface, the cells being smaller and more numerous towards the posterior pole, which is most active in its rate of development (Fig. 1). This layer is the blastoderm. A few cells are subsequently formed by the nuclei remaining in the center, but the protoplasm in the center being scanty, the rate of development is retarded or partially suppressed.

This mode of development is a kind of gastrulation, showing a transition to epiboly, in which the peripheric protoplasm would be confined to the spot over the germinal sac. The largeness of the egg and the distribution of protoplasm all over the surface, cause the difference. The few cells formed in the center represent the endoderm.

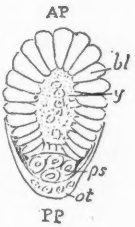


Fig. 1.

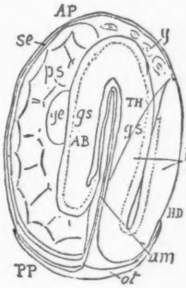


Fig. 2.

FIG. 1.—Ovum with blastoderm completed and pseudovitellus beginning to invaginate. FIG. 2.—Germ-streak, lateral plates and amnion are completed; yolk becoming exhausted; pseudovitellus enclosing genital layer and part of germ-streak. The dotted line indicates the commencing mesoblast.

3. *Peculiar to Aphides.*—Cells from the epithelium of the ovarian tube form an appendage to the posterior pole of the egg. A single cell is given off from these, which repeatedly divides so as to become a cell-mass. These increase by absorbing food, and afterwards became invaginated as a greenish mass, called *pseudovitellus* (*ps*). This is destined to be received dorsally into the embryo and to become paired masses in the abdomen. The

[1] Explanation of reference letters in the figures; *AB*, abdomen; *AP*, anterior pole; *HD*, head; *PP*, posterior pole; *TH*, thorax; *am*, amnion; *at*, antennæ; *bl*, blastoderm; *br*, brain; *ec*, ectoderm; *ge*, generative cells; *gs*, germ-streak; *lp*, lateral plate; *md*, mandible; mx^1 mx^2, first and second maxillæ; *ot*, ovarian tube-cells; p^1 p^2 p^3, first, second and third thoracic limbs; *pc*, procephalic part; *prc*, proctodæum; *ps*, pseudovitellus; *se*, serous layer; *sg*, salivary glands; *st*, stomodæum; *y*, yolk.

inside of the ovarian-tube cells (*ot*) remain as an appendage to the posterior pole of the egg.

4. *Formation of Germ-streak.*—Energetic cell multiplication at the posterior pole causes a new invagination at that place (Fig. 2). One side of the invaginated part is of thick cells, this is the *germ-streak* (*gs*) (ventral plate of Balfour), and ultimately the embryo; the other side of the invaginated part is of thin cells, this becomes the amnion (*am*). The blastoderm remains thin, except where it adjoins the outer extremity of the germ-streak, where it is thickened so as to form lateral plates (*lp*). Thus embryo and amnion are both buried in the center of the egg; the embryo bends ventrally, the abdomen curving round so as to approximate to the posterior pole, and to have appendages and amnion within its bend. The head end is at the place of invagination, lateral plates coöperating with the extremity of the germ-streak towards the formation of head and brain.

The central position of the embryo is characteristic of the lower orders of insects, which are therefore termed *entoblastic.* These include Hemiptera, Orthoptera and probably Thysanura. The higher orders, as Hymenoptera, Lepidoptera, Coleoptera, Diptera and perhaps Neuroptera, are *ectoblastic,* having a ventral plate formed on the surface, afterwards sinking slightly under the blastoderm, and having the anterior pole of the egg the more active. The ectoblastic condition seems to be a case of anticipation of changes which must afterwards be encountered by the inferior forms (see section 14 below).

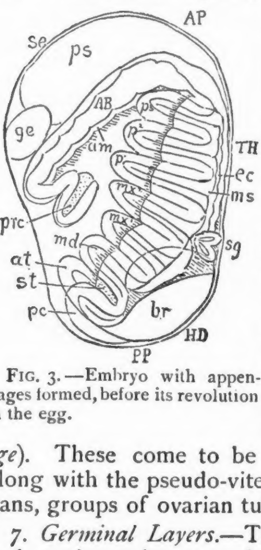


FIG. 3.—Embryo with appendages formed, before its revolution in the egg.

5. The blastoderm being now thin becomes the *serous tunic* around the whole egg.

6. *Genital Cells.*—A few large cells arise at an early stage inside the blastoderm, near the place of invagination (*ge*). These come to be ultimately received into the embryo along with the pseudo-vitellus, and become paired generative organs, groups of ovarian tubules.

7. *Germinal Layers.*—The germ-streak divides into an outer and an inner layer, each cell dividing into an outer and inner part. Thus are formed *ectoderm* and *mesoderm* (*ec, ms* in Fig. 3; also indicated by the dotted line in Fig. 2). The few cells formed in the center of the egg are the only representatives of endoderm. (In ectoblastic insects the mesoblast is formed by an infolding of ectoderm.)

8. The *appendages* next show themselves, those of the head

arising first; and the body becomes segmented, the head having three (afterwards four) segments; the thorax three and the abdomen seven or eight (afterwards ten, including the telson). Thus seventeen would be the maximum number of somites of the insects.

9. *Alimentary Canal.*—An invagination for the mouth is seen (*stomodæum, st*), and subsequently another for the anus and intestine (*proctodæum, prc*). These meet each other in the body so as to complete the alimentary canal. The stomodæum forms œsophagus and stomach; proctodæum forms intestine and rectum. The mid-intestine is not chitinized, but this is related to its function and has no embryological significancy.

The true endoderm becomes yolk-balls, afterwards wandering cells, subserving nutrition, but not directly aiding in the formation of the alimentary canal or of any other organ. The author excludes the endoderm from any share in forming the intestine in all Aιthropods, if not more widely.

10. The *appendages* now shew their special characters. They arise by an evagination of the body wall, including ectoderm, mesoderm and part of the body cavity. Thus arise the mandibles and two pairs of maxillæ in the head; these keep small as compared with the limbs; the mandibles and first maxillæ afterwards combine to form a retort-like mass. The antennæ arise beside the stomodæum, in the same way as the other appendages (not from the procephalic part). The abdominal segments bear minute projections, probably rudimentary limbs.

11. The *procephalic part* is not originally lobed in Aphides; it arises as an extension forwards of the antennal segment. It subsequently becomes pointed and forms the labrum.

12. The *ventral nerve-cord* arises from the ectoderm, its cells dividing so as to leave only a thin dermal layer. Transverse segmentation causes it to be marked off into ganglia (three anal, three thoracic, seven abdominal, which are small). These subsequently coalesce into a subœsophageal and ventral mass.

The *brain* is formed in the region of the lateral plates, but its primitive relation to the ventral cord was not made out.

13. *Body-cavity.*—The general body-cavity represents the original segmentation-cavity. In an early stage free polar-cavities are formed between blastoderm and yolk, thus corresponding to the segmentation-cavity of lower animals. These cavities uniting insert themselves between the yolk and germ-streak, and extend into the embryo and its appendages. The same cavity spreads under the serous layer as a separate cavity. In the early stages the embryo is open dorsally, and by this route the pseudo-vitellus and generative mass find admission to its interior. Between the embryo and amnion is an "embryonal cavity" derived from the lumen of the ovarian tube.

14. *Revolution of Embryo.*—When the parts of the body and

the appendages are well formed (after the stage indicated in Fig. 3) the whole embryo changes its position in the egg, so as to approach the original attitude of the ectoblastic embryos. The abdomen is shifted away from its proximity to the head and thorax. The head moves to the anterior pole; the abdomen to the posterior pole; the curvature of the embryo becomes changed so as to invert the relation of dorsal and ventral aspects.

15. *Tracheæ.*—Seven pairs of minute invaginations appear on the sides of the abdomen, and afterwards two pairs in the thorax (sometimes a third in the thorax and an eighth in the abdomen, giving a maximum of eleven pairs). These are the entrances of the tracheæ whose inner extremities are afterwards united by longitudinal tracheæ. The salivary ducts from the third postoral segment to the salivary glands (*sg*) arise in a similar way, and seem to be homologous with tracheæ.

16. The *heart* is formed as a solid cylinder of mesoblast in the dorsal region. It afterwards becomes hollow, the central cells probably becoming blood corpuscles; is constricted at intervals and obtains alary muscles and valves.

17. *Cornicula.*—The "sugar-tubes," or cornicula, have no sugar or honey, but urates, which are discharged from secreting cells within. They arise as thickenings of the abdominal walls. It is not the honey but the excrement of Aphides that ants seek after. There are no malpighian vessels in Aphis, their function being perhaps vicariously discharged by the cornicula.

18. The wings arise by evaginations of the dermis, the two plates curving to flatten themselves.

19. The following developmental periods appear to be generally applicable to insects:

(1) Preparatory to organ-budding: as segmentation, gastrulation, formation of blastoderm, of germ-streak, and of embryonal skin.
(2) Organ-budding.
(3) Growth of these organs, and appearance of some new ones before hatching.
(4) Post-embryonic development of larva; now the generative organs reach full development.—*G. Macloskie.*

NERVE-TERMINATIONS ON ANTENNÆ OF CHILOGNATH MYRIOPODS. —A preliminary note upon these structures is contributed by O. Bütschli; the results were worked out by Dr. B. Saupine in conjunction with Dr. Bütschli, but having been left in an incomplete condition, a brief *résumé* of the more important new facts seemed desirable.

Previous observers have noted the occurrence of conspicuous structures upon the antennæ of Chilognatha, which correspond to the so-called olfactory cylinders of insects recently studied in detail by Hauser, and between the two there seems to be a general similarity.

Each of the sensory processes is entered by a nerve which immediately divides into two branches, each covered with ganglionic cells which are distributed in two groups, the anterior one consisting of considerably smaller cells than the posterior ones; at the distal extremity the nerve-fibres again collect into a bundle and form the termination of the organ; that these fibers are differently constituted from those which enter the ganglion from above is shown by the fact that their behavior to staining reagents is different; the sensory process is often at the free extremity so that a direct communication is established between these nerve-endings and the outer world.

A structure essentially similar to this is found in Vespa, but is differently construed by Hauser; according to him the posterior group of cells is not present, since he only figures one nucleus *with several nucleoli*, however, while the anterior group of smaller cells has escaped his attention; accordingly the conclusion to which Hauser has arrived at is that the whole sensory structure is a single cell; whereas in reality it consists of a great number of cells.—*Journ. R. Micr. Soc., August, 1884.*

Poison Apparatus and Poison of Scorpions.—J. Joyeux-Laffuie, from his own studies and a consideration of what has been discovered by other naturalists, comes to the conclusion that the poison organ of the scorpion (*L. occitanus*) is formed by the sixth or last somite of the post-abdomen, which terminates by a sharp process, at the extremity and sides of which are two oval orifices by which the poison escapes. There are two secreting glands, each of which opens by an excretory duct to the exterior. Each gland is situated in a cavity, which it completely fills, and which is formed by the chitinous skeleton and by an enveloping layer, formed by striated muscular fibers; it is by the contraction of this latter that the poison is forced out. The gland has a central cavity which acts as a kind of reservoir, and a proper wall, which is formed by a layer of cells that send out prolongations into the cavity, and of a layer of epithelial cells, which, in the fresh condition, have a finely granulated protoplasm; these are the secreting cells. The poison is very active, and, even in weak doses, soon kills most animals, and especially arthropods or vertebrates. The phenomena of poisoning are always the same, and take place in the following order: (*a*) pain at the point of injury; (*b*) period of excitement; (*c*) period of paralysis. The conclusions which are characteristic of the second stage, are due to the action of the poison on the nervous centers, and especially on the brain; the paralytic phenomena are caused by the action of the poison on the peripheral extremities of the motor nerves, where they appear to have the same influence as curare. The muscles, the heart, and the blood are in no way attacked, and the poison may therefore be certainly placed among those which act on the nervous system. The scorpions found in France (*S. europæus*

and *S. occitanus*) cannot cause the death of a human subject, and are only dangerous when several poison a man at the same time, or attack very young children. To judge by his bibliography, the author is unacquainted with the observations on the habits of scorpions, published in 1882, by Prof. Lankester.—*Journ. R. Micr. Soc., August, 1884.*

OCCURRENCE OF TACHINA FLIES IN THE TRACHEÆ OF INSECTS.—N. Cholodkowsky gives in Zool. Anzeiger (June 9) an account of a young larval Tachina 1 ^{mm} long found in the ventral stigma of a carabus beetle. He afterward found the same kind and another species of Carabus infested with fully grown Tachina maggots. He also found a *Harpalus ruficornis* literally packed with these larvæ. The occurrence of Tachina larvæ in the bodies of grown-up insects is, he adds, no new thing. In 1828 Bohéman found in *Harpalus ruficornus* and *aulicus* the larvæ of *Uromyia curvicauda;* Léon Dufour described *Hyalomyia dispar* as a parasite of *Brachyderus lusitanicus;* he also found the larva of Phasia in *Pentatoma grisea* and *Cassida viridis* and the larva of *Ocyptera bicolor* in *Pentatoma grisea.* Boye in 1838 took Tachinæ from three species of Carabus. Within a few years Künkel d' Herculais found the maggot of *Gymnosoma rotundatum* in the body of Pentatoma.

EATON'S MONOGRAPH OF RECENT EPHEMERIDÆ. Part II.—We have already (p. 630) called attention to this elaborate work. This part concludes the descriptions of the species as well as the nymphs when known. A most important feature of this part is the illustration of the nymphs, which have been drawn with great detail and engraved by A. T. Hollick, filling twenty large plates. Between this magnificent work and the elaborate memoir by Vayssière, as well as the papers of Joly, the Ephemerids certainly have no reason to complain; though their own lives scarcely span a day, their historians have devoted years of research to them.

STRUCTURE AND FUNCTION OF THE LEGS OF INSECTS.—We have already called attention to this essay by F. Dahl. The Journal of the Royal Microscopical Society for October contains an abstract of it, which our entomological readers will find of interest. The constancy of the number of six legs is probably to be explained as being in relation to the functions of the leg as climbing organs; one leg will almost always be perpendicular to the plane when the animal is moving up a vertical surface; and on the other hand we know that three is the smallest number with which stable equilibrium is possible; an insect must therefore have twice this number, and the great numerical superiority of the class may be associated with this mechanical advantage. This theory is not weakened, but rather supported, by the fact that the anterior pair of legs is rudimentary in many butterflies, for these are almost exclusively flying animals.

The author describes in some detail the arrangements of the muscles of the legs; the nerve-cord supplying them is pretty stout, and the large number of filaments sent to the joints of the tarsus lead to the supposition that these have a tactile function; the nerve-fibers are seen to enlarge into thick spindle-shaped ganglia. There are two tracheal trunks.

The prime function of the leg is locomotor, and insects move through gaseous, fluid and solid media. The last is seen in fossorial forms, of which Gryllotalpa may be taken as the type; here some of the joints are flattened out and provided with teeth, and the muscles are well developed.

In some cases, legs of a fossorial type are possessed by insects which move on the ground, but the larvæ of which are subterranean in habitat. The water-beetles and aquatic Rhynchota have the legs converted into swimming organs; they are widened out into plates, and provided at the sides with movable hairs, which are directed slightly backward. The median pair of legs in Corixa is provided with two very long hooks, the function of which is to fix the animal at some depth among the water-plants, and so to prevent its floating upwards.

In the aërial forms, we have first to notice those that move on the surface of the water; in these the legs are often provided with considerable enlargements of the tracheal trunk, by means of which they are enabled to float. Others have very long legs, by which they can balance themselves and extend over a large surface of the water; the lower surface of the tarsal joints, or that which is in contact with the water, is provided with thick hairs. In some Diptera hairy lobes are developed. Arrangements for climbing are very widely distributed, and are very various in character; the most common are hooks, which by their sharp tips are able to enter the smallest depressions, and so obtain a firm hold; sometimes they are pectinate and enabled to catch hold of fine hairs.

In very many cases there are organs of fixation; in the locust they have their chief mass made up of a large number of free flexible rods (not tubes). The periphery is occupied by scales which correspond in number to the rods, with which they appear to be connected by fibers; the space between the rods is filled with a fluid. Below these are groups of spindle-shaped cells which appear to be glandular in character. The fixing surface of the Hymenoptera, Neuroptera, and Lepidoptera consists of an impaired lobule placed between the hooks; their structure is most complicated in the first-named order. Observations on *Vespa crabro* did not result in the detection of any space which could be regarded as a vacuum. The lower surface of the lobule is soft and almost smooth; a few short hairs may be developed at its base; below this is a hard chitinous mass with stronger hairs. The upper surface is either covered with hairs or is finely folded. Near the base is a chitinous plate carrying a pair of strong setæ.

Within is an elastic bar, which is rolled up in a condition of repose; when extended it brings the lobule into contact with the surface on which the insect is standing. There are no well-developed gland-cells. After descriptions of other modes of fixation, the author gives the following table:

A. Organs of attachment at the end of the foot.
- *a.* Without fixing hairs .... *Orthoptera.*
- *β.* With fixing hairs .... *Forficula.* *Coleoptera.* *Sialis.*

B. Organs of attachment between the hooks.
- *a.* A distinct median lobe.
  - *a.* The median lobe with chitinous arches.
    - 1. Secondary in addition to the median lobe .... *Neuroptera.*
    - 2. No secondary lobes .... *Hymenoptera.*
  - *b.* No chitinous arches .... *Lepidoptera.* *Tipula.*
- *β.* No distinct median lobe.
  - *a.* The lobes hairy .... *Diptera.*
  - *b.* The lobes not hairy .... *Rhynchota.*

The legs may, further, have a sexual function as attaching or holding organs; or, as in *Mantis religiosa*, *Nepa cinerea*, etc., they may be of use in seizing prey; and, finally they may be used as cleansing organs. The legs in ants may be seen to be pectinate, an admirable arrangement for forms that live in dust and earth; they are often especially adapted for cleansing the proboscis and for other functions, for an account of which we must refer to the paper itself.

ENTOMOLOGICAL NOTES.—Dr. Brauer, says *Psyche* (Aug., Sept.) has noticed the transformations of a fly (*Hirmoneura obscura*) whose larva lives on that of the grub and pupa of the June beetle, *Rhizotrogus solstitialis*.——Mr. O. Lugger, according to *Science Record* has discovered a strange hymenopterous parasite infesting the larva of Tiphia, a black sand-wasp. The Tiphia lays its eggs in the larva of our June beetle (*Lachnosterna fusca*); the larva of Tiphia when nearly mature eats the white grub and then spins for itself a beautiful silken cocoon. This larva in turn is often infested by the larva of *Rhipiphorus pectinatus* or *R. limbatus*, the eggs of which have become fastened to the Tiphia, and in this way reach the Tiphia cocoon. Mr. Lugger has also found in the same cocoons small hymenopterous parasites.——Interesting cases of lack of symmetry among insects are described in *Psyche* by O. P. Krancher.——Mr. P. Cameron states in the *Entomologist's Monthly Magazine* for October that since the publication of the first volume of his Monograph of British Phytophagous Hymenoptera, wherein he gave an account of what was known up to that time of the occurrence of parthenogenesis in sand-flies, he has been able to prove experimentally its existence in thirteen additional species, including *Lophyrus pini*, of which males were bred.——The second number of Vol. XI, of the Transactions of

the American Entomological Society contains a synopsis of North American Trichopterygidæ, by Rev. A. Matthews, of England. He regards this as the most extensive family of the whole order of Coleoptera. Dr. Horn notices the species of Anomala of the U. S. and gives a synopsis of the U. S. species of Notoxus and Mecynotarsus, while pp. 177 to 244 are devoted to a synopsis of the Philonthi of boreal America.——Among the papers of value to American students in parts 1–3 of the Transactions of the Entomological Society of London, are Elwes' additional notes on the genus Colias; E. B. Poulton's notes upon or suggested by the colors, markings, and protective attitudes of certain lepidopterous larvæ and pupæ, etc.; Lord Walsingham's North American Tortricidæ; E. Saunder's notes on the terminal segments of aculeate Hymenoptera, and Forsayeth's life-histories of sixty species of Lepidoptera of Central India.——The Transactions of the Imperial Zoölogical-botanical Society of Vienna, for 1884, are rich in valuable entomological papers. Dr. R. Latzel describes (p. 127) two new species of Eurypauropus, myriopods of the order Pauropoda, from Austria, showing that this genus is common to North America and Europe.——In the same volume von Wattenwyl, under the title "Ueber hypertalische nachahmungen bei den Orthoptera," notices and illustrates two cases of mimicry of dead colored leaves by a Phaneropterid grasshopper. The second form is wingless and strikingly resembles a worker ant. It is named *Myrmecophana fallax.*——The fourth part of the Transactions of the Entomological Society of London contains, among other papers two of much general interest by Baron Osten Sacken, *i. e.*, facts concerning the importation or non-importation of Diptera into distant countries, and an essay on comparative chætotaxy, or the arrangement of characteristic bristles of Diptera.——A carefully prepared and very just tribute to the memory of our greatest entomologist, Dr. John L. LeConte, by S. H. Scudder, appears in advance from the Transactions of the American Entomological Society.——We have received a well illustrated report on the tea-mite and the tea-bug of Assam, by J. Wood-Mason, of Calcutta; the mite puncturing the leaves so that "a badly smitten garden may be recognized from a distance by its red color," and the bug also blighting the leaves. It appears that of the two species of tea plant cultivated in Assam the indigenous species which affords the strong and rasping liquor, when pure, enjoys an almost complete immunity from attack, while the milder juices of the imported Chinese bush render it liable to attack. Mr. Mason then asks how the bugs distinguish between different but closely similar plants, infallibly selecting the right food-plants for their larvæ.——At a meeting of the London Entomological Society held July 2, Dr. Sharp remarked that *Cybister ræseli* has been kept alive from five to seven years by being fed on earthworms once or twice a day.——Dr. Witlaczil has published in

the Transactions of the Vienna Academy of Science an essay on the polymorphism of an Aphis (*Chætophorus populi*).——A new cave-spider, says *Science-Gossip* for December, has been found in a cave in Tasmania, the female of which measures six and a half inches from tip to tip of the fore and hind legs.——Sharp has detected on the prothoracic stigma of the beetle (Chalcolepidius) trap-door-like lobes closing them so as to prevent the entrance of small mites (Proc. Ent. Soc. London, p. iii).

ZOÖLOGY.

THE DEEP-SEA EXPLORATIONS OF THE "TALISMAN" (*continued*). —The Sargasso sea was then visited, and deep-sea soundings made to ascertain the nature of the bed of that part of the ocean. From Cape Verde, the ocean gradually deepens toward the 25th parallel, when it attains a depth of 6267 meters; but it gradually rises toward the Azores, and, under the 35th parallel, it is not over 3175 meters deep. These results are far from being in accord with the indications on the charts of the Atlantic ocean recently published, where the curves of depth give very considerable inequalities.

Whenever soundings were made, specimens of a very fine ooze, formed of fine particles of pumice, mixed with globigerina, were brought up. This ooze, at first reddish near the Cape Verde islands, afterward became of an almost pure white. Each time the dredge furrowed the face of the sea bottom, it was more or less filled with fragments of pumice stonea nd of volcanic rocks. It would seem as if there were, more than a league under the sea, a great chain of volcanoes parallel to the African coast, and of which the Cape Verde islands, the Madeiras, the Canaries and the Azores were the only points of emergence.

The submarine fauna there is scanty. To the stones were attached brachiopods (*Discina atlantica*). A blind Fusus (*Fusus abyssorum*), and a new genus of Lamellibranchs (*Pygothcca fragilis*), as well as several Pleurotoma, occurred. Some Crustacea, such as hermit crabs (*Pagurus pilimanus*), which lodge in colonies of Epizoanthus, and which have already been dredged on the African coast, some amphipods of the genus Nematocarcinus, Holothurians of the group of Elpidia, of which one species was new, Asterians, Ophiurans, and rare corals, scarcely indemnified the party for the time given to dredging at such great depths.

It was only toward the north limits of the Sargasso sea, near the Azores, where the depths are 3000, 2500 and 1400 meters, that our collections became abundant. The 11th of August, at 2500 to 2900 meters, the *Talisman* party captured the giant of the family of Schizopodes—a Gnathophausia, of a blood-red, measuring almost 0.25 millimeters in length, and meriting well the specific name of Goliath, which has been applied to it. In

the same dredge with this crustacean was found a fish of the group of Stomias, with lateral phosphorescent plates. Further on, at 1500 meters, several mollusks of unknown species (Scaphander, Pleurotoma, and Oocorys), the *Dentalium ergasticum*, a great variety of Crustacea, Holothurians, Asterians, Ophiurans and other Echinoderms, contrasted with the penury of the preceding days.

After visiting Fayal, the *Talisman* explored the uneven volcanic bottoms of the passages between the Azore islands, making several successful hauls at the depth of 1250 meters. Some fishes, large red Aristes, Heterocarpus, Galateas of the genus Diptychus, a squid (Cirrhoteuthis) peculiar to Greenland, Actinias, whose edges close together like a bivalve, many star-fishes, specimens of Lophohelia, with their usual retinue of Mopsea, soft sea-urchins (Calveria), large and beautiful Holtenias, recalling the dredgings some weeks previously off the coast of Morocco.

At a little distance from St. Michel, the declivity of the sea-bottom is very rapid. Some hours after our departure, our sounding apparatus already indicated almost 3000 meters, and some of the species found on the plateau situated west of Cape Ghir were brought up. Among others, some large Holothurians, of an amethystine color. On the following day the depth was 4415 meters, and for four days after it continued to be about the same. 4060 meters the 24th, 4165 the 25th, 4255 the 26th.

The very large fishes of the genus Macrurus, which had been brought up during the expedition, also occurred here. They differed fromt hose of lesser depths. The Scopeli and Melanoceti were here also associated. Some hermit crabs and Galatheas of new form; some Crangons, with red eyes; a gigantic Nymphon of the genus Colossendeis; some Ethusas, different from those already known; some Amphipods and Cirripedes represented the Crustacea.

But this abyssal fauna owed its special physiognomy to the large Holothurians of strange forms which abounded; some whose length reached 0.65 millimeters, and whose violet colors were very intense, belonged to a new species of the genus Psychropotes, so remarkable from the existence of a very much developed appendage, ending behind the body, and resembling a queue; others, of the genus Oneirophanta, were easily recognized by their pure white color and long appendages, which garnished the whole body. Others of a delicate rose, carried on the back an erectile, fan-like membrane; these new Pentagonias were like those found by the *Challenger* at the greatest depths explored. Finally, large Actinians, some of which lived as parasites on the Holothurians, some Hymenasters, Asterians, a Brisinga with few arms, some Ophiurans and a crinoid, were found in the same situations.

Aug. 27th, the sounding apparatus reached a depth of over

5000 meters, and a new species of Neæra, and different Crustacea occurred with others previously dredged. More than fifty rosy Pentagonias were dredged, mixed with a less number of Oneirophanta, Archaster and Ophiomusium, attested the richness of this deep sea fauna.

The bottom of the sea throughout this region is carpeted with a white ooze formed almost entirely of globigerines. Pumice and volcanic stones are mixed with it; but that which surprised us most was to find some pebbles polished and striated with ice at a distance of more than 700 miles from the coast of Europe. The distinctness of the striations could not allow us to admit that these pebbles had been transported by currents, because they would never have rolled, and, besides, they lay at such a great depth, that the tranquillity of the water there should be very great, to judge by the nature of the ooze deposited there. Their presence is probably due to transportation by floating ice, which, during the quaternary epoch, advanced further south than in our day, and which, melting in the part of the Atlantic ocean lying between the Azores and France, let the stones fall on the bottom with the fragments of rocks torn from the bed of the glaciers, and which they had transported there.

Aug. 30th, dredging at the depth of 1480 meters in the Gulf of Gascony, revealed polyps of the genus Lophohelia, with splendid Pentacrini (*P. wyville-thompsoni*), gigantic Mopseas, Gorgonias, and corals, etc.—*A. S. Packard.*

The Nervous System of Antedon.—Various opinions have been held in regard to the nervous system of the crinoids which has been held by some to consist of the bands along the bottom of each ambulacral groove corresponding to the nerve cords of the star-fish, while others have maintained the nervous nature of the axial cord and its connections. Dr. Carpenter first suggested the nervous nature of this cord in 1865, and in 1874 further developed the theory that the axial cords are nerve-trunks, and the five-chambered organ in the centrodorsal basin is their center, and as proof adduced the fact that an eviscerated specimen suddenly and consentaneously closed its ten arms when a needle was thrust into the chambered organ. P. H. Carpenter, in 1876, was the first to maintain the nervous character both of the sub-epithelial bands of the ambulacra and of the axial cord. Recent experiments, carried on by Dr. A. M. Marshall, have established conclusively that the central capsule and axial cords, with their branches, constitute, as maintained by the Carpenters and Perrier, the main nervous system, while the sub-epithelial bands are also probably nervous, but have only a special and subordinate function in connection with the ambulacral tentacles and epithelium. The complex co-ordinated movements of swimming and righting when inverted, are all executed by the axial system, as was

proved by the fact that eviscerated specimens in which the connection of the sub-epithelial bands with each other was destroyed, were capable of executing these movements. The axial cords act both as afferent and efferent nerves. Evisceration causes apparently but little inconvenience to the animal, and the visceral mass is regenerated completely in a few weeks. The apparent morphological difference between the nerve system of the Crinoidea and of other echinoderms disappears upon examination. Taking the Asterids as the lowest term of the series, it will be found that in those creatures, as shown by Hamann, nerve fibrils are found over the entire dorsal surface of the animal. While in Ophiurids, Echinids and Holothurids the ambulacral portion of the continuous nervous sheath of the star-fish has concentrated into a well-defined cord, the remainder being absent; in the crinoids the ant-ambulacral or dorsal part being continuous nerve-sheath of the star-fish has developed into the so-called axial cords, and the ambulacral bands also subsist as a subordinate nerve-system.

HERRICK'S CLADOCERA AND COPEPODA OF MINNESOTA.[1]—In this excellent report we have for the first time a summary of the known genera and species of all our fresh-water, free swimming Entomostraca with the exception of the Ostracodes. It will prove not only useful but stimulating to our inland naturalists. As a pioneer work it is entitled to much credit, since many of our species are identical with those of Europe, and much care is required in the generic and specific descriptions, since the distinctions are based on such slight characters. In the introduction the author shows how important these micro-crustaceans are as scavengers, and in what astonishing numbers they exist, 1442 specimens occurring in a quart of filthy pond water.

The discussion of the affinities and genealogy of the Cladocera is interesting; this is succeeded by an account of the leading works on them. The order, families and genera are characterized with sufficient fullness, and a tabular view of the classification of the Cladocera is given, as well as useful keys to species under each genus. Under the family Daphnidæ a long account of the circulatory system is given from original observations, The Copepoda are treated in the same manner as the other order, and all the species collected by Mr. Herrick or previously known are described, but why no description of *Canthocamptus tenuicaudis*, n. sp., is given, we hardly understand, though it is figured, while *C. cavernarum* Pack., from Mammoth cave, is not mentioned. The number of species of Copepoda seems meager, and

[1] A final report on the Crustacea of Minnesota, included in the orders Cladocera and Copepoda. Together with a synopsis of the described species in North America, and keys to the known species of the more important genera. By C. L. Herrick. From the twelfth annual report of the Geological and Natural History Survey of Minnesota, 1884. 8vo, pp. 191, with 29 plates.

as the author suggests, many new forms remain to be detected. Notes on collecting and preserving these forms, and a few descriptions of marine copepods from the Gulf of Mexico are added. The figures are numerous and fairly well drawn, some being anatomical and embryological in their nature.

The work will do credit to the author and be of service in directing attention to these creatures, and it is to be hoped that the author will be able to add to and extend the work, and in a few years give us an enlarged and improved edition of it, as a hand-book of our fresh-water Entomostraca would be useful.

The plates should have been numbered not lettered; *Limnetis* is spelt *Limnetes*, but the typographical errors are not numerous.

Morphology of the Vertebrate Auditory Organ.—The chief vertebrate sense organs have certainly had a very different origin. The olfactory organ is probably a modified gill (Marshall). The eye is developmentally and really part of the brain. Such a view was also once held with regard to the olfactory and auditory nerves as well as the eye. But recent researches, especially those of Marshall and Van Wijhe, have proved that the auditory nerve is merely a dorsal sensory branch of the 7th cranial nerve (3d segmental nerve of Van Wijhe).

It has been shown above that the nerves which supply the segmental sense organs are dorsal sensory branches of the segmental nerves, that the segmental sense organs are merely modified portions of the epiblast, that these sense organs primitively, and in some existing form still throughout life, lie free on the surface of the body, but that later in most cases they become shut off from the epidermis in a sac which remains connected with the external world by a small opening. The sensory cells of these organs possess long fine terminal hairs, which are easily affected by wave-motions in the medium in which the animal lives, and which communicate this wave motion to the nerves connecting them with the brain. Do we really meet with this condition of things in the auditory organ? In other words, is the auditory organ merely a specially modified portion of the system of segmental sense organs?

The auditory organ is, like the segmental sense organs, really a modified portion of the epiblast. Very early in development it becomes shut off in a sac from the epidermis, a condition which only arises later in the segmental sense organs.

The semicircular canals, etc., are clearly secondary complications, for in every embryo the auditory organ is at first a simple sac shut off from the epidermis, of which sac a portion of the inner wall consists of two layers of modified epiblastic cells, connected by a dorsal sensory branch of a segmental nerve with the brain.

This double layer of modified epiblastic cells is in every way

comparable to a segmental sense organ. As in the latter the cells on the free surface possess long hairs. These hairs like those of the segmental sense organs are concerned with the perception of wave-motions of the medium in which the animal lives. The hairs on the auditory cells are indeed concerned with the perception of much finer wave-motions—those of sound—than those on the cells of the segmental sense organs, and hence arises the early shutting off of this organ from the skin. The inner layer of cells of the auditory organ is exactly comparable to the inner layer of cells of a segmental sense organ.

In Teleostei, etc., the auditory organ becomes entirely shut off from the skin, but in Elasmobranchii the aperture of invagination persists, and the organ is connected with the surface throughout life, just as the segmental sense organs.

These facts, together with the fact that the auditory nerve is merely a dorsal sensory branch of a segmental nerve, seem to point to the conclusion that the auditory organ of vertebrates is fundamentally a specialized portion of the system of sense organs of the lateral line, specialized above the rest of the system by the acquirement of the more delicate function of the perception of waves of sound.

In accordance with, and as a direct consequence of this function of receiving waves of sound, the auditory organ has been early shut off from the external surface, and has developed accessory structures in the shape of semicircular canals, etc. Thus its primitive simplicity has been lost.

I hope shortly to give elsewhere a more detailed statement of the points touched upon in this paper.—*John Beard in Zoölogischer Anzeiger, 1884.*

SOME PRELIMINARY NOTES ON THE ANATOMY OF FISHES.—I. *On the cutaneous Sense-organs.*—Since the distinction between *endknospen* on the one hand, and *nervenhügel, nervenleisten, nervenknöpfe* on the other, is generally recognized, it becomes desirable to have English equivalents somewhat less clumsy than the literal translations of these terms. I have found no satisfactory word to replace " endbud," but would suggest for the " nerve-hillocks " and other sense-organs of the same character, whatever their shape, the term *neuromast* with the adjectival form *neuromastic.*

At the meeting of the British Association in Montreal, in September, I pointed out that the catfish possesses neuromasts in sacs, recalling those of the sturgeon. They resemble these, in fact, more closely than do the similar structures of Amia and Lepidosteus, which I have recently studied. The neuromasts belonging to a group are connected by a canal lodged in the corium, which is lined and in places filled by an epithelium, continuous with the epithelium of the neuromasts. Such a canal

has recently been described by Carrière for Cobitis, although he has not recognized its true character. The deep neuromasts found by the same author in Tinca are evidently somewhat similar to those of the catfish, and it is probable that connecting epithelial canals will yet be found. The only explanation of these canals which has so far occurred to me is, that they are the remains of a more complicated system of cutaneous canals similar to those of the Selachii.

In striking contrast to such deep neuromasts are those lodged on the projecting papillæ of the blind fishes. Professor S. A. Forbes has described the distribution of these in his *Chologaster papilliferus*, a specimen of which he has kindly given me for examination. I find that whereas the trunk in this species has only the free neuromasts, the head has neuromastic canals arranged in the ordinary way, and corresponding roughly in their course to the chief tracts of the projecting papillæ. A singular circumstance is, that they have only four openings on each side, one posterior above the gill-aperture and three anterior on the snout, the pores of the mandibular, infraorbital and supraorbital canals respectively.

I take the opportunity of mentioning here that the absence of pigment in the pigmentary epithelium of the retina of this species as very significant.

2. *On the fate of the spiracular cleft in Amia and Lepidosteus.*—It is generally supposed that the spiracles of the sturgeon are unrepresented in Amia and Lepidosteus, but a minute slit may be seen in both genera on either side of the roof of the mouth, immediately in front of the dorsal ends of the first branchial arches, leading into diverticula of the mouth-cavity—the rudimentary spiracles. If a bristle be pushed into one of these slits, it will be found to pass through a canal in the primordial cranium immediately above the anterior end of the hyomandibular articulation, and to be only prevented from emerging on the roof of the skull by the squamosal bone. Sagemehl has seen the canal in Amia without attributing to it any morphological significance. In series of sections through young specimens of both genera, I find a free neuromast projecting from the epithelium of the anterior wall of the distal part of the cleft, supplied by a distinct division of that dorsal branch of the *trigeminus* (the *ramus oticus* of Van Wijhe), which is distributed to the neuromastic canal in the squamosal bone. I conclude that the distal part of the cleft is epiblastic in origin, although Balfour believed (as far as Lepidosteus is concerned) that it never acquires an opening to the exterior. In a recess of the anterior wall of the spiracle in Amia is situated a pseudobranchia. This has recently been styled an "opercular pseudobranchia," in accordance with Gegenbaur's views as to the homology of the pseudobranchia of the Teleosts, but the discovery of its relations to the spiracular cleft demon-

strate its homology with the pseudobranchia of the sturgeon. As there can be no doubt of the homology of the pseudobranchia of Amia with that of the Teleosts, it follows that it is the "opercular" gill and not the spiracular gill which disappears in the Teleosts. Dohrn has recently defended this from another standpoint. Johannes Mueller' sview is in opposition to that of Gegenbaur.

The pseudobranchia appears to be represented in Lepidosteus by a mere anastomosis. That genus, has, however, an "opercular" gill (absent in Amia), the two parts of which, although differing in their vascular supply, correspond to the complete opercular gill of the sturgeon. Balfour was unable to find this gill in young specimens of an inch in length. I have arrived at the above result from the study of specimens of two inches.

3. *On the auditory organ of Hypophthalmus.*—In a recent paper I described the connection between the air-bladder and auditory organ in the catfish (Amiurus), paying special attention to the morphology of the modified anterior vertebræ which establish this connection.

Reissner had previously pointed out that in many tropical Siluroids this "Weberian apparatus" is much reduced, but his identification of the altered vertebræ is so out of harmony with my results that I was glad to be able to re-investigate the matter through the liberality of Professor B. G. Wilder, who put at my disposal last spring a number of the forms in question as well as others. As was to be expected, the four anterior vertebræ are always modified in a similar manner throughout the group.

The genus Hypophthalmus, according to Günther, presents an exception to the other Siluroids, in that the anterior vertebræ are not united, but as a fact this genus exhibits an extreme type of reduction of the Weberian apparatus. The four anterior vertebræ are not only united, but the first three of them are telescoped, as it were, into the occipital region of the skull, so that a frontal section through the plane of emergence of the third pair of nerves, falls also through the *sacculi* of the auditory labyrinth. The air-bladder is represented by two entirely separate bladders, about 2^{mm} in length by 3^{mm} in width, almost entirely enclosed in osseous capsules, situated on either side of the fourth vertebra, and coalesced with it. These osseous capsules represent the crescentic ossifications in the external tunic of the air-bladder of the catfish which are attached to the posterior ends of the "*mallei*." All the Weberian ossicles are represented, but the whole apparatus is so reduced as to be obviously quite functionless. In conformity with this the *lagenar* parts of the auditory labyrinths are much smaller than in the catfish, while the *sacculi* of opposite sides still communicate by a transverse duct.

In compensation, as I think, for the reduction of the Weberian apparatus, the neuromastic canals of the head and trunk are

enormously developed, and the dorsal branches of the various cranial nerves which supply these, and which center in the *tuberculum acusticum* of the brain, are correspondingly large. This appears to me an additional confirmation of the theory advanced by Schultze and Mayser, that the cutaneous sense-organs of this class constitute a form of auditory organ.—*R. Ramsay Wright, University College, Toronto, Dec. 18, 1884.*

P. S.—After writing the above, I learn from Professor Wilder that he indicated the existence of rudimentary spiracles in Amia and Lepidosteus at the A. A. A. S. in 1878. His MS., which remains unpublished, discusses the nature of the spiracles and their persistence in a more or less complete form in Selachians, Ganoids and the Teleost Megalops, describes the form and relations of the spircular clefts in the adult Amia, and concludes that these are open in the young.

The relation of the pseudobranchia referred to above is not indicated.—*R. R. W.*

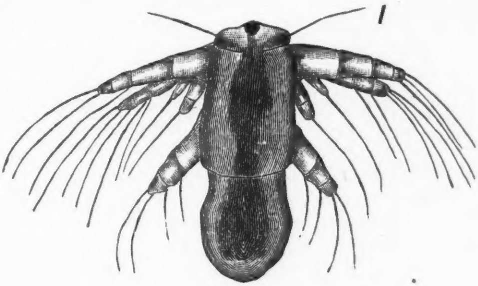
THE LARVA OF ESTHERIA MEXICANA.—(The following descriptions and figures were received from the late Mr. V. T. Chambers in 1873, and overlooked in the preparation of my monograph of North American Phyllopoda. As we know nothing of the development of American Estheriæ except what is given by Dr. Gissler in my monograph, it may be well to publish the drawings and description of Mr. Chambers. I have identified the species from specimens of the shell sent by the author.—*A. S. Packard.*)

I send by this mail the fragments of the shell of the Estheria and two camera drawings of the nauplius in different stages, and a drawing of a section of the shell showing the markings. I do not know whether the nauplius has been previously figured or not, as my knowledge of the genus is confined mainly to Baird's monograph in *Ann. and Mag. Nat. Hist.*, Ser. 2, Vol. VI, p. 53; T. R. Jones in *Quar. Micro. Journal*, and a few references in the *Zoölogical Record.*

Most probably this is your described Kentucky species.[1] Out of the hundreds of eggs only four produced Nauplii, and unfortunately I was only able to observe these in the stages figured. The first form (Fig. 1) was evidently just from the egg, and was observed at 3 o'clock P.M., Sept. 15; the second was observed next day at 8 A.M. I have a preserved specimen of each form: Fig. 2*a* is the shield, which seems to be attached only to the anterior portion of the under side of the thorax; Fig. 2*b* is a side view of the head at this stage, except that the abdomen is too short. Fig. 1 bears a good general resemblance to Baird's figure of *Artemia iun.* It seems to me, however, to approach more

[1] *E. clarkii*, now regarded as a synonym of Claus' *E. mexicana.*

nearly the young of Chirocephalus, especially in Fig. 2.—*V. T. Chambers.*



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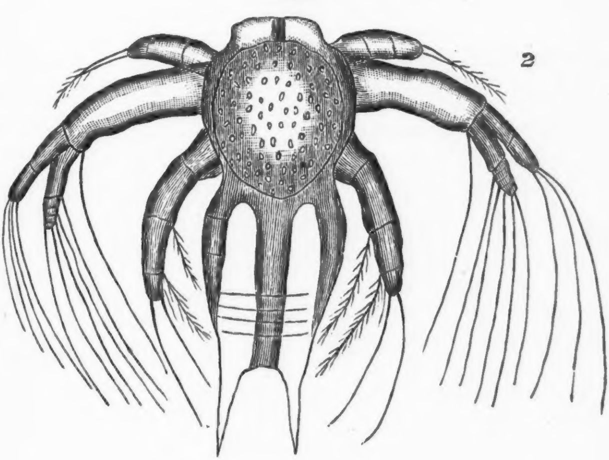

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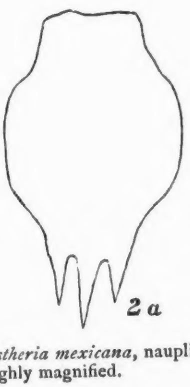
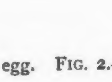


2 *a*



2 *b*

FIG. 1.—*Estheria mexicana*, nauplius just from the egg. FIG. 2.—After the first molt. All highly magnified.

Aberration in the Perch.—I wish to note a peculiar anatomomical aberration in a common perch (*Perca americana*) which has just come under my observation. In examining some of these fishes from Lake Michigan, an assistant noticed that one of them had no pyloric cœca. The viscera were placed in alcohol with others, and on opening the alimentary canal for the purpose of removing its contents, I noticed a fleshy mass apparently nearly occluding the pyloric opening, the pyloric portion of the stomach being stretched somewhat tightly over it. Finding that this was not detachable I took it for a tumor, but a closer examination showed that it was divided into three finger-like lobes, of the shape and size of pyloric tubes, and that each of these lobes was hollow, opening upon the outer surface of the intestine by an orifice large enough to admit a knitting-needle. Evidently these were the missing pyloric cœca, which had *grown wrong side out*; for I cannot conceive of any accident which should turn these structures within the body of the fish.

The exposed surface is a mucous surface, and that within the cavity of the pyloric tube is a serous surface, like that of the outside of the intestine.—*S. A. Forbes.*

A Lizard Running with its Fore Feet off the Ground.—In the proceedings of the Linnean Society of New South Wales, 1884, it is stated that Mr. Macleay exhibited a lizard which was observed to run for six yards in an erect posture with the fore legs quite off the ground. The lizard was of the genus Grammatophorus, of which there are several species in the country, all of them much given to playing and gambolling on sunny days.

Feathers of the Dodo.—The feathers of the dodo have been studied by Professor Moseley, who read a paper on the subject at the Montreal meeting of the British Association. He showed that the arrangement of the feathers in groups of three each in the dodo had a close connection with the *filoplumæ*, or thread-feathers, one of which is found at each side of the feathers of birds of the dove family, near which the dodo is placed. Earlier in the development of the dove's feathers the *filoplumæ* are larger, relative to the size of the other feathers; and this condition resembles still more the structure found in the dodo.

The Armadillo in Texas.—G. H. Ragsdale, of Gainesville, Texas, informs me that an armadillo was recently killed in northern Denton county, Texas, which is the only animal of the kind ever taken in that part of the country. The armadillo is said to have been common on the Rio Grande river twenty years ago, and is still common in the south-western counties of Texas.—*A. Hall (E. Rockfort, Ohio), in Forest and Stream.*

Another Swimming Woodchuck—On page 249 of Dr. C. Hart Merriam's interesting work on the Mammals of the Adirondacks (New York, 1884), the author states that with the ex-

ception of a single case which came under his personal observation, and which he relates in full, he has searched in vain for the record of an instance where a woodchuck (*Arctomys monax*) has been known to swim voluntarily. An instance somewhat similar to the one mentioned came under my own notice in the early part of July, 1877, whilst camping within a few miles of the village of Kempville, some thirty-two miles south of Ottawa. In company with Mr. P. B. Taylor, of the post-office department, I was rowing up "the Branch," a small tributary of the Rideau, when we noticed a large woodchuck come down the bank and take boldly to the water, with the evident intention of crossing to the other side. The stream was at this point about 30 or 40 yards wide, and we pulled hard in order to come up with the animal before he could reach the opposite shore. As soon, however, as the woodchuck saw us he appeared to take in the situation, and made vigorous efforts to escape; and as he could change his direction much more quickly than we could, he succeeded for some time in eluding us. But we finally managed to get within reach of him and I lifted him into the boat by the back of the neck. He shivered a good deal and looked intensely uncomfortable; but his long swim did not appear to have tired him much, for he struggled violently to free himself, and when subsequently released he leaped over the side of the boat and swam back to the shore from which he had come. He swam low in the water, progressing but slowly and with evident exertion.—*W. L. Scott, Ottawa, Canada.*

Nest of Neotoma floridana (identified by Dr. Coues, with question).—While hunting, the other day, my attention was called to a singular nest of some animal, made on the ground, just in the edge of a clump of mesquite brush. It was in the form of a pyramid or rather oval, about two feet and a half high, and four feet in diameter at the base, constructed of cow chips, stones, sticks, lumps of dirt, and every imaginable light substance that could be collected in the vicinity. There were two holes for entrance in the nest, on opposite sides, about the size of one's coat sleeve. A large thick cactus leaf near one of the orifices had been partly eaten recently. As far as we could ascertain, without destroying the nest, it was unoccupied at the time of our visit. My companion, the signal observer here, is very familiar about here, but this is the only nest of the kind he has seen. A gentleman, who has lived on the Rio Grande, says he has seen them. Can any one tell us what animal lives in this curious nest?—*John D. Parker, Fort McKavett, Texas.*

Haacke's Discovery of the Eggs of the Australian Echidna.—It appears that on Aug. 25, a few days before the announcement (Aug. 29) by telegraph from Australia, of Caldwell's discovery that a monotreme laid eggs, the telegram not

stating whether it was the Ornithorhynchus or Echidna, Dr. J. W. Haacke discovered that Echidna laid eggs. His discovery was reported in the same number of the *South Australian Register* as contained Caldwell's dispatch to the British Association at Montreal. On Sept. 2d, at a meeting of the Royal Society of South Australia, the *Register* reports: "Dr. Haacke laid a number of specimens on the table, including an egg found in the pouch of a female Echidna, in support of the theory that the Echidna, although a milk-giving animal, lays eggs which are hatched in the pouch." Dr. Haacke, in a communication to the *Zoologischer Anzeiger* of Dec. 1, adds: "I found the egg on the 25th of August last in the mammary pouch (not the uterus) of a living *Echidna hystrix*, received about the 3d of the same month from Kangaroo island. The egg was unfortunately decomposed inside, but the circumstance of the mother having been worried by being captured and kept in captivity easily accounts for this." He also says that in dissecting the Echidna he felt a small object in the pouch; in hopes of finding a young Echidna he brought it to the light, and was astonished to behold a veritable egg between his fingers! It was from one and a-half to two centimeters in diameter, and possessed, as many reptilian eggs, a pergamentaceous shell which, under the pressure of his fingers, burst, letting out thick fluid contents. The scientific public will now look with interest to Mr. Caldwell's account of his discovery.

Distribution of Mammals.—At the Montreal meeting of the British Association Dr. G. Dobson read a paper on the distribution of mammals, in which he pointed out the remarkable resemblance between certain bats of the Australian and Ethiopian regions. From this it was apparent that some communication once existed between those continents. There probably had been a chain of islands between Australasia and Africa, which had existed for a short period, by which route the bat had passed from one place to another. Bats were widely spread in Madagascar, Mauritius, and Australia, but there is only one species in India which shows a strong resemblance to the Madagascar bats. So it is evident that at no distant day they had common ancestors. It was, therefore, deduced that there must have been a chain of islands from Australia to Madagascar, and at a later period from Madagascar to India. On close examination he felt convinced that the Indian ocean contained many submerged banks between Australia, Madagascar, and India. Professor Moseley said that the Indian ocean had never been examined as to depth, the *Challenger* expedition not touching it. Dr. John Ball urged that the existence of islands and continents was often too dogmatically laid down; he believed that currents could carry trees which might bear animals and plants with them.

ON THE CENTRALE CARPI OF THE MAMMALS.—Professor H. Leboucq, in his "Recherches sur la morphologie du carpe chez les mammifères," Arch. de Biol. Tom. v, 1884, pp. 35–102, pl. III–VI, has made extended communications on this subject. I will add some observations, which will complete Leboucq's results. In this present communication I will speak of the centrale only, and will defer other points discussed by Leboucq to a future extended paper on the morphogeny of the carpus and tarsus of the vertebrates. I have found, like Leboucq and others, a distinct central bone in man, dog and cat. I regret not having been able to examine embryos of bats and marsupials. I can distinguish a centrale in two other specimens of Carnivores, in an embryo of Lutra of 50^{mm}, and in an embryo of *Mustela vulgaris* of about 25^{mm}. In Lutra the central bone was quite free and very fully developed, the radiale and intermedium were coalesced. In the embryo of Mustela, very much smaller and younger, the centrale was beginning to coalesce with the radiale and intermedium, at that part contiguous to the radiale. In Lutra the radiale and intermedium were entirely coalesced, in Mustela I found traces of a former separation.

In an embryo of *Erinaceus europæus* of 65^{mm}, I found no sign of a free centrale and no indication of a confluence of the bone with the radiale. The first tarsal row consisted of two pieces of cartilage, a radiale and intermedium, and an ulnare. In an adult *Erinaceus collaris* I observed the same condition as in the embryo. As in the different families of Insectivores, even in the adult state, a free centrale may be found or not, I do not hesitate to believe, that in all Insectivores in which a centrale has not yet been seen, such a bone will be discovered in embryos at some early stage of their development.

In regard to the Marsupials I have had no opportunity to examine the embryo.[1] In the manus of the following adult Marsupials I can distinguish an os centrale coalesced with the radiale, as Leboucq has stated, viz: *Didelphys azaræ*, *Perameles lagotis* and *Dasypus maculatus*. Further I can state the same for Ornithorhynchus and *Myrmecophaga tetradactyla*.

A centrale carpi is therefore now shown to occur in all orders of mammals except the Ungulata and the Cetacea.

Hyrax capensis possesses, as is well known, a free central bone. Professor Cope places the Hyracoidea together with the Condylarthra in the order Taxeopoda, and considers these the oldest ungulates. If there is a free centrale in one of the oldest ungulates, *Hyrax capensis*, such a bone should exist in the allied forms of this and in the descendants of the Taxeopoda, and I have no hesi-

[1] Since writing the above, I have distinguished in an embryo of Didelphys, 9.5^{mm} long, a partially free central bone. My thanks are due Professor H. Osborn for the opportunity of making the examination.

tation in believing that such a bone will be found in the Amblypoda[1] and in embryos of Elephas, Tapir, Rhinoceros and Hippopotamus. Whether it is coalesced with the radiale or with the trapezoid (tars. II) or whether it has become wholly atrophied, I am not able to decide. (According to Flower: Osteol. of Mamm., II edit., p. 265, in *Hyrax dorsalis* the central bone is coalesced with the trapezoid.) It would be interesting to know whether in the Periptychidæ, the Phenacodontidæ and the Meniscotheridæ, the three families of Cope's Condylarthra, indications of a central bone can be found. It seems improbable that such indications must exist. Furthermore in regard to the Cetacea. If Leboucq's hypothesis, that we might consider in these animals certain "metacarpiens" as "carpo-metacarpiens" should be shown to be correct, then this last point would be elucidated.

Further morphogenetic researches on the limb-skeleton of the vertebrates will remove many present uncertainties and errors. I would hence be glad to receive, from those interested in the subject, any embryological material that will enable me to make further investigations upon these points. The most important stages are, when cartilage begins to appear, or is already developed. In future studies I hope, so far as possible, to elucidate the morphology of the limb-skeleton of vertebrates and to bring to light new points on the phylogenetic relations of the different groups of vertebrates.—*Dr. G. Baur, Yale College Museum, New Haven, Conn., Oct. 1884.*

THE TRAPEZIUM OF THE CAMELIDÆ.—Professor Cope[2] says in regard to the carpus of Poëbrotherium, one of the ancestors of the Camelidæ: "The carpus consists of eight bones, the entire mammalian number, all entirely distinct. The second series presents the most important peculiarities. The trapezium is small and posterior; the trapezoides has an almost entirely lateral presentation, and is also small, and fits an angle of the magnum. There are two principal and two rudimental metacarpals. The second and fifth are very short and wedge-shaped, and closely adherent in shallow fossæ of the third and fifth, respectively."

It is generally considered that the living Camelidæ have no trapezium. I cannot, however, agree with this assumption. At the posterior part of the trapezoid of an adult *Camelus bactrianus* L., I find a well developed articular surface; it is the same face that is seen in different Cervidæ,[3] and can only be for the trapezium.

[1] Professor Cope believes that there is an os centrale ("intermedium") in Coryphodon.

[2] Annual Report of the U. S. Geol. and Geog. Survey for 1873. Washingion, 1874, p. 499.

[3] Baur, G. Der Carpus der Paarhufer. Eine morphogenetische Studie (Vorläufige Mittheilung). Morphol. Jahrb. 9, 1884, pp. 600.

Between Poëbrotherium and the living camels stands, according to Professor Cope,[1] the genus Procamelus. In regard to this latter, Cope says, p. 262: "Thus the lateral rudimental metacarpals of Poëbrotherium have disappeared, and with them the trapezoides of the carpus." (This is evidently a typographical error; instead of trapezoides it should read trapezium.)

Now if there is a trapezium in one of the living Camelidæ, as I have found, there ought to be one in the older form—Procamelus. That this is in fact so, seems apparent from the figure given by Cope[2] of *Procamelus occidentalis* (Pl. LXXIX, fig. 3*a*). There appears to be an articular surface, at the back part of the trapezoid and it would be interesting to prove it definitively.

The presence of a trapezium in the Camelidæ shows that they, like the Cervidæ, are ancestral forms of the ruminants. I will discuss this in another place.

I do not doubt that we will find in the carpus of camel embryos the same condition as in Poëbrotherium. It would be interesting to examine embryos with this view.—*Dr. G. Baur, Yale College Museum, New Haven, Conn., Nov., 1884.*

LAST APPEARANCE OF THE BISON IN WEST VIRGINIA.—The following letter we owe to the kindness of Professor J. Packard of the Theological Seminary of Virginia. The facts regarding the last date of the appearance of the buffalo in West Virginia will be interesting in connection with the statements in J. A. Allen's work on the American bison, living and extinct.

PRINCETON, MERCER COUNTY, W. VA., April 26, 1877.

Your letter was received several days ago, and would have been answered before this, but was delayed by me with the hope of arriving at such information as some of the oldest of our citizens might be in possession of, which I expected to obtain at our last week's court. I have failed to get but little beyond the slight traditions I had before; to sum it all up, I think the last buffalo killed on Guyan river was killed by a man named Morgan, on a creek and at a lick called Buffalo, about four miles from its mouth that empties into said Guyan, and about fourteen miles from Logan C. H., and in the County of Logan, in the year 1804. Another one was killed, and perhaps the last one heard of, by Joseph Workman on the Deer Skin fork of Coal river, about the year 1810. This information I got from old Stephen Blankenship, who is now in his eighty-sixth year. I learn that old Mr. Workman is still living, and is ninety-five years old; the buffalo was killed in the present County of Boon, where he now lives. My impression was, before the receipt of your letter, that the last one

[1] Cope, E. D. The Phylogeny of the Camelidæ, Proc. Ac. Nat. Sci. Phil., 1875, p. 262.

[2] Report Expl. Surv. W. of 100th Mer. U. S. G. M. Wheeler in charge, IV, pt. 2, 1877.

was killed on Coal river, but think they did not remain in the State later than about 1805. A few elks lingered longer, perhaps as late as 1820. I think you might obtain, perhaps, the most accurate information in reach from Col. Benj. H. Smith (P. O. Charleston, Kanawha county, W. Va.), who is an intelligent old gentleman, and has practiced law in all the counties where the buffalo was seen last, he, I think, would likely remember the hunters' account of his departure from the State.

N. B. French.

Zoological Notes.—*Worms.*—The despised earthworm appears, from a letter of Mr. F. E. Beddard to *Nature*, to be capable of attaining considerable dimensions. *Megascolex cœruleus*, said to be abundant after heavy showers in some parts of Great Britain, is represented in the British Museum by specimens more than two feet long. Two distinct genera of large sized earthworms, *Antæus* and *Titanus* Perrier, inhabit South America. The genus Acanthodrilus, from Western Africa, has two species which attain a length of three feet. An earthworm two to three feet long occurs in the interior of New Zealand, and a similar one in South Australia. But the largest known species is from South Africa. Forty years ago Rapp figured an earthworm six feet two inches long, obtained near Port Elizabeth, and recently Mr. Beddard procured a living example of the same species between four and five feet long and half an inch thick, from the same locality. It expands and contracts within wide limits, and may even be longer when fully expanded. Externally it resembles Lumbricus, in having four series of pairs of bristles on each segment, but its internal structure is quite distinct. This worm seems to be abundant, but is rarely seen, as it is only driven from its underground burrows by heavy and prolonged rains; on such occasions, which only occur a few times a year, the ground is covered by hundreds of these creatures, slowly crawling around until killed by the sun. A curious fact in connection with these worms is that the hard clayey soil in which they reside contains brackish water, thus proving that the presence of salt does not necessarily kill earthworms and their eggs, as has been supposed. The genus Pontodrilus Perrier lives among decaying seaweed cast up by the sea. ——Earthworms would appear to be exceedingly abundant in some parts of New Zealand, if we may judge from Mr. Urquhart's paper, in the transactions of the New Zealand Institute. The writer calculates that there are in one acre of pasture land near Auckland, 348,480 worms, with a weight of 612 pounds 9 oz.

Crustaceans.—In describing the head of *Palinurus lalandii*, Professor T. Jeffrey Parker divides the genus Palinurus into three sub-genera. Species in which the stridulating organ is absent, and the procephalic processes present are named Jasus; those with the stridulating organ and without the procephalic processes, Palin-

urus; while Gray's name, Panulirus, is retained for the longicorn species. All the species of Jasus (omitting *P. longimanus* and *P. frontalis*, of which no definite information could be obtained), are confined to the southern hemisphere, those of Palinurus to the northern, while those of Panulirus occur in both.

Fishes.—Mr. R. M. Johnston, in the Proc. Roy. Soc. of Tasmania, enumerates 188 known species of Tasmanian fishes. Of these about one-third are good edible fish, though only twenty-one are sufficiently abundant to be of importance. *Lates colonorum*, a well-known species in Australia, seems, in Tasmania, to be confined to one small river on the north-east of the island.

Mammals.—Mr. G. E. Dobson states that many of the most characteristic species of Australian Chiroptera have their nearest allies in the Ethiopian region. Thus Chalinolobus and the subgenus Mormopterus are South African and Australian. *Megaderma gigas*, of Queensland, has its nearest ally in *M. cor* from Eastern Africa, and Triænops, a remarkable leaf-nosed bat found in Madagascar, Eastern Africa, and Persia, has its nearest ally in the *Rhinonycteris aurantia* of Australia. Finally, Australia agrees much more closely with Madagascar, and the Mascarenes than with the oriental region, in the species of Pteropus, eighty per cent of which inhabit the Australian region and Madagascar, with its islands.——Mr. G. E. Dobson (Proc. Zöol. Soc., April, 1884) describes the myology and visceral anatomy of *Capromys melanurus*. The specimens on which the description is based were from the mountains of the southern end of Cuba, and appear to be the first of which the complete bodies preserved in spirit have reached Europe. The four known species of Capromys, *pilorides*, *brachyurus*, *prehensilis* and *melanurus* are confined, so far as known, to the islands of Cuba and Jamaica, where they are the only indigenous rodents. *C. brachyurus* is limited to Jamaica, the others to Cuba. The liver of this species differs remarkably from that of *C. pilorides*, in the absence of that sub-division of the hepatic lobes, which has been described in the latter species, and has been thought a generic character.——M. Testut (Bull. de la Soc. Zool. de France, VIII, 1883) has observed in twenty subjects the fusion of the flexor muscle of the thumb with the general flexor of the digits. As the presence of a separate muscle for the flexure of the thumb, causing that digit to be perfectly independent in its movements, is one of the characters made much of by those who wish to find a broad difference between man and the apes, it is significant to find this character so often absent. In three cases the two flexors were completely united into a single muscle. To meet with this character it is necessary to go back to the Cercopitheci, for in the anthropoid apes the muscles have a greater or less tendency to separation. In the gorilla, the flexor muscle divides into two parts, one of which goes to the thumb and first finger, the other to the re-

maining three fingers. This anomaly was found by M. Testut on both arms of one subject. In the orang, not only are the two deep flexors united, but there is no tendon for the thumb, and this abnormality has been observed in man by Gruber, Wagstaffe, Gegenbaur, and Chudzinski. M. Testut believes that he can trace the presternal muscle, which in three or four per cent of the human subjects that have been dissected is present, and is connected above with the sterno-mastoid tendon and below to the great oblique, to the condition of things which obtains in serpents (or rather in vertebrates deprived of a sternum) in which the great oblique is attached to the mastoid apophysis. The sterno-mastoid and great oblique muscles are identical in their position with regard to the tegument, their direction, and their insertion on the haemal axial line, but where a sternum is present, the muscular fibers which descend from the mastoid apophysis find insertions upon it and upon the clavicle, and the part intervening between these insertions and what is now the great oblique becomes atrophied. Muscular anomalies are frequent in man, but M. Testut, in an important work upon this subject, shows that the muscles subject to these anomalies, which disappear entirely in some, while in others they are abnormally developed, are muscles which play an unimportant part in the human economy, and are links which unite man to the lower animals.

EMBRYOLOGY.[1]

THE DEVELOPMENT OF THE RAYS OF OSSEOUS FISHES.[2]—Since the time when Vogt published his work on the development of the salmonoids, in 1842, it has been known that the earliest traces of rays to be noticed in the fin-folds of young fishes were fine, very numerous filaments, lying parallel to each other. Th. Lotz,[3] in 1864, carried Vogt's observations farther, and thought he showed that by the coalescence of these filaments the rudiments of the permanent rays were laid down. Both A. Agassiz and myself have found these filaments in the embryo of numerous widely separated genera of teleosts; the former having also pointed out their existence in Lepidosteus. They also exist permanently in an almost unmodified form in the Dipnoans, as shown by the researches of Günther and others. Balfour and myself have found these filaments in all of the fin-folds of Elasmobranchs, though they seem to be wanting in the more fleshy pectoral of some of the Rays. They are present in the fin-folds of embryo sturgeons, and there probably give rise to the permanent

[1] Edited by JOHN A. RYDER, Smithsonion Institution, Washington, D. C.

[2] Abstract of portion of a paper on the theory of the fins, to be published, with plates, in the Proc. U. S. Nat. Museum.

[3] Ueber die Schwanzwirbelsäule der Salmoniden, etc. Zeitsch. f. wiss. Zool., XIV, 2 Heft.

osseous rays as in Teleosts, but in very young Amphibians and Marsipobranchs they are absent, and in Amphioxus the development of the so-called rays at the bases of the vertical fins is so entirely different, according to Kowalevsky's account, that they are manifestly not homologous with the homogeneous embryonic radial filaments found in the fins of true fishes (Ganoids, Dipnoans, Teleosts, Elasmobranchs and Chimæroids).

In all the forms so far made the subjects of observation, these embryonic filaments are much more numerous than the permanent rays, and appear clearly defined in sections between the mesoblast and epiblast which constitute the fin-folds when the rays are being formed, these filaments then become covered externally by a more or less clearly defined layer of mesoblast about one cell deep, or, if they are not forced inwards in this way, they coalesce directly to form the basement membrane of the permanent rays. Usually, however, they are forced inward by the radial proliferation of the mesoblast spoken of above, and they then degenerate, their substance being apparently carried out to the surface of the mesoblastic core of the permanent rays by a process of metabolism to form the basement membrane of the latter which is crescentic in sections, and immediately overlaid externally by the integument. As this new formation takes place proximally it would appear that the primitive radial filaments had coalesced by their parallel sides distally, and fused into a continuous semi-tubular strip of basement membrane which maintains its more primitive fibrillated form distally or at the margin of the fin, thus giving rise to the dichotomous structure of the right and left halves of which a caudal fin-ray is almost always composed in osseous fishes.

The primitive radial fibers (=embryonic fin-rays of A. Agassiz) appear first at about the end of the lophocercal stage around the end of the tail and in the pectorals. In Gadus embryos, three weeks old, the first traces of these filaments appear at the end of the tail, in the vertical fold surrounding its extremity, as numerous elongated cells with fine protoplasmic prolongations extending in one direction toward the axis of the body and in the other away from it. These spindle cells are arranged like the filamentous rays which develop later, that is, their processes extend nearly parallel to the processes of those adjacent. These rudiments of the embryonic filaments bear a remarkable resemblance to cells found imbedded in the rays of Ceratodus, as figured by Günther in his memoir on that form. I will therefore call them *pterygoblasts;* their origin is mesoblastic and not epiblastic. They develop into the embryonic radial filaments, but the extent to which these are differentiated in the median fins of Teleosts is very variable. Amongst those forms which have continuous median fin-folds developed as well as a pre-anal fin-fold, Salmo is the only form known to me which has them developed through-

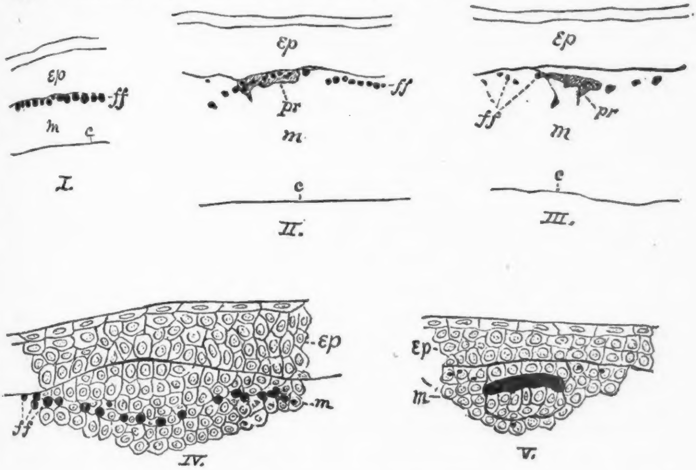
out the entire extent of those folds; Alosa, also a physostomous form, does not have them developed nearly so extensively at a corresponding period. In forms with discontinuous folds, as Siphostoma, for example, they are not very evident even at the time when the caudal rays are being formed, but aside from such exceptional forms they seem to be almost universally developed to some extent in the fin-folds of all truly fish-like forms except the lampreys and the lancelet.

In consequence of the striking resemblance which this stage of the development of the rays of the most specialized fishes bears to what has remained nearly permanent, with but comparatively little modification in the Chimæroids, Elasmobranchs, Ceratodus and Protopterus, I propose to call this the *protopterygian stage* of the development of the fin rays in the Teleostei. The primitive fibers in section are shown to be perfectly cylindrical and homogeneous, and so far as histological tests enable me to judge, are perfectly similar in composition to the homogeneous semitubular matrix derived from the former, in which ossification occurs to form the permanent rays. Active metabolism evidently occurs at the base of the fin-folds about the time the permanent rays are in process of development, for the reason that after the stratum of fibers becomes covered externally by mesoblast in this situation they rapidly atrophy leaving nothing but the semitubular rudiments of the permanent rays, crescentic in section, which now lie between the epiblast and mesoblast resting upon thickened tracts of the latter internally and which radiate toward the margin of the permanent caudal fin-fold; the proximal ends of these mesoblastic cores rest upon the distal end of the upturned chorda.

The segmentation of the permanent rays has not been traced, but this evidently occurs before ossification has gone very far, as it is manifested quite early in the caudal rays of certain types. It is doubtless due in part to the bendings which the rays suffer while in *use.* The rudiments of these rays are imperfectly tubular in all forms, spines also having such a form at first, though frequently these have an external layer added by coalescence with dermal plates or denticles.

The main conclusion, therefore, at which I have arrived in this investigation is the following: that it is the mesoblast which is involved in giving origin to the fibrous embryonic rays and that that layer also effects their transformation into the rudiments of the permanent rays, and not the epiderm or embryonic integument, as heretofore generally held by anatomists. The whole history of the fin-folds in fact favors such a conclusion, since the horny fibers develop between the corium and epidermis or embryonic skin, in the plane of the *protomorphic* line of Huxley. The fin-folds of embryo fishes, it should be borne in mind also, are at first wholly epidermic, the corium or true skin being only developed during the later-larval or post-larval life.

During my observations on the development of Gadus, made in 1881, I noticed a space which exists between the skin and muscle-plates (see Pl. x, Figs. 43 and 44, Contrib. Embryog. of Osseous Fishes), since then Carlo Emery[1] has published his observations founded on a study of transverse sections of the tails ot



EXPLANATION OF FIGURES.

Portions of vertical transverse sections of the caudal fin of a salmon embryo, showing the development of the halves of the permanent rays of one side.

FIG. 1.—*ep*, deep and superficial layer of epiblast; *m*, mesoblast; *c*, center of mesoblastic tissue proliferated into the dermal tail fold; *ff*, filamentous embryonic fin rays cut transversely near the margin of the caudal fold.

" 2.—From a section nearer the base of the fin to show the process of fusion of the primitive rays, *pr*. The other letters as before.

" 3.—From a section in which the rudiment of the permanent ray, *pr*, is covered by mesoblast, the filamentous rays, *ff*, having been still more thickly enveloped on the outer or epiblastic side by the mesoblast than in Fig. 2. Traces of the presence of the filamentous embryonic rays can be seen in the substance of *pr* in this and the foregoing figure.

" 4.—From a section through an outer caudal ray near its base, showing the fibers *ff* enveloped externally by the mesoblastic core of the permanent ray, which forms a swelling which is cut across, on the top of which the first traces of the proximal end of the permanent ray appears.

" 5.—Section through the basal part of a median ray, the primitive fibers in the vicinity having nearly disappeared, the ray itself again becoming covered externally by proliferated mesoblast. All of the figures enlarged 365 times, the cells being shown only in the two last.

embryos of Fierasfer, Belone and Lophius, in the early lophocercal stage. In these he finds a homogeneous secretion interposed between the muscle-plates and the epiblast, extending also into

[1] Sulla existenza del cosidetto tessuto di secrezione nei vertebrati. Att. R. Accad. Sci., Torino, XVIII, 1883.

the fin-folds, beside some scattering stellate mesoblastic cells which very possibly may be the pterygoblasts, which either themselves give rise to the embryonic rays or are indirectly concerned, together with the surrounding tissues, in pouring out such a homogeneous secretion. Such homogeneous substances I have found in other cavities in embryos, especially in the brain; in such cases I have been inclined to attribute their presence to the action of reagents, as extractive matters, as homogeneous, hardened acid-albumen, in short. The early advent of mesoblast into the fin-folds is at any rate a settled point, the stellate cells which wander outwards being mesenchymal, according to the terminology of the Hertwigs. In embryos of Scomberomorus I do not find the secretion noticed by Emery, homogeneous during the lophocercal condition, but loosely granular, more like the fine plasmic corpuscles found by me between the vitellus and zona radiata of the egg of Amiurus. At any rate I am not inclined to believe, after weighing the foregoing facts, that there is the slightest ground for the assumption that the fin-rays of fishes originate from the primary epiderm or larval integument, but that they arise from the mesoblast, as their position and first vascular supply would indicate. The distinction between the fin-rays as *exoskeletal*, from the other bones as *endoskeletal*, therefore breaks down on embryological grounds; for both are clearly of mesoblastic origin, as is further proven by the mode in which the insertions of the muscles which move the fin-rays originate.—*John A. Ryder.*

PSYCHOLOGY.

Dogs as Newspaper Carriers.—A very common thing on all the Connecticut railroad lines is for accommodating train men to throw newspapers off the trains at or near the houses of subscribers living on the line of the road at a distance from the stations. In many instances dogs have been trained to watch for the cars and get these papers, and country dogs, it is noticed, take quite an active interest in the affair. Over on the Naugatuck road some one has had the curiosity to inquire into this matter of dog messengers. Mr. Philip McLean, proprietor of the Gate House, on the Thomaston road, has a dog who goes a mile and a half every morning to meet the train. The paper was formerly thrown off by the brakeman on the last car, and there the dog watched for it. Lately it has been thrown from the baggage car. The dog appeared angry at the change, barked furiously, and waited sullenly for some time before going on his errand. He has not yet become reconciled to the new way of delivering his paper. Below Derby a dog has acted for several years as newsboy for a number of families. The papers are thrown out of the cars under full speed. Whether one or a large bundle of them, the dog is able to lug them off, making good time back. Another dog who has become a veteran as newsboy and cannot now, from age and rheu-

matism, get down to the cars, has in some way managed to train a younger dog to do his work. Edward Osborne, residing below Naugatuck, has a dog who regularly meets the early morning train. The house is a mile away from the railroad, and the dog never leaves on his errand until he hears the train whistle at Beacon Falls station. Then he starts on a run and waits at the same spot always, with his nose poked between the palings of a fence and his keen eyes watching for the flying paper. A story is told of one dog that was first taught to bring a certain New Haven paper, and when his master changed to another could not be induced to carry the new one. This is unlikely. Another story is that the late Senator William Brown, of Waterbury, had a pet dog that could readily distinguish the whistles of the New England engines from those of the Naugatuck, though running on a parallel track at the same time side by side. The faithful dog always found his train and car, and stood in waiting for the Hartford *Times*, which he carried home to his master for many years.—*Hartford* (*Conn.*) *Times.*

Hearing and Smell in Ants.[1]—In the investigation of the senses of the lower animals, especially of invertebrates, the best efforts of the student are often rendered inconclusive from the fact that, for aught we know, the sense-organs possessed by them may respond to vibrations which produce no effect upon us, and thus they may possess senses of which we have no idea, though they may lack what we can identify as hearing, taste, or smell. So long as a creature possesses eyes, we feel sure that it sees, though we may know that its perceptions are very limited; but it will not do to say that an animal cannot hear, only because it cannot hear sounds audible to us. For this reason Sir J. Lubbock carefully guards himself from the assertion that ants cannot hear; although all attempts to induce them to take notice of sounds audible to us proved failures. Not content with trying the most intense and the most acute sounds upon a colony of ants, and also upon single ants, he endeavored to ascertain whether ants could produce sounds intelligible to themselves, though inaudible to us. To this end he placed some honey upon one of six small pillars of wood set upon a board frequented by the members of a domesticated colony of *Lasius flavus.* Three ants were placed at the honey, and then imprisoned near it; then three others, which were also imprisoned. Numerous ants were moving round the board in search of food, and Sir J. Lubbock reasoned that if ants can make any sound intelligible to other ants, the imprisoned ants would tell the searchers of the food. On the first occasion only seven ants found the honey in three hours—no more than visited the pillars which had no honey. But when the ants which had eaten the honey were

[1] Résumé from the *Revue Scientifique*, of an extract from the work of Sir J. Lubbock, entitled Ants, Wasps and Bees, Experimental studies on the organism and habits of hymenopterous insects.

freed, fifty-four ants found the honey in half an hour. Other days of experiment resulted in the same manner. Thus it became evident that, if the imprisoned ants made sounds inaudible to us, those sounds had no meaning to their companions. A sensitive flame was not affected by anything the ants did, and a microphone, though it made their footsteps audible, gave no indication of any other sound. Remembering, however, that all vibrations between 35,000 per second, the highest perceived by the human ear, and 470,000,000 per second, which produce the sensation of red light, are only perceived by us as heat; and mindful also of the curious sense organs present upon the antennæ, Sir John Lubbock is still of opinion that ants have a sense cognate to what we call hearing. These antennal organs are of two kinds, one of which occurs in other insects, but the other seems to be peculiar to ants. The latter consist of an exterior and interior chamber, connected by a long narrow tube. A nerve ends in the interior chamber. The whole apparatus resembles a stethoscope, and Professor Tyndall and Sir J. Lubbock are of opinion that it serves for a similar purpose. Besides a group of these in the terminal segment of the antennæ, there are one or two in each succeeding segment. Moreover, ants have an apparatus consisting of several serrated ridges at the junction of some of the abdominal segments, and similar to an organ which in *Mutilla europæa* produces sounds audible to us. The inference is, that since Mutilla is not very distantly related to the ants, the apparatus possessed by the latter serves a purpose similar to that possessed by the former.

Experiments made upon the sense of smell showed that ants ear very sensitive to odors that produce the sensation of scent in us.

Psychical Research[1].—The Proceedings of the Society for Psychical Research are certainly remarkable amongst the literature of the present century and, rightly considered, are amongst the most interesting. The reports of the various committees are published primarily for the edification of the members, but they also court public criticism, and as a simple matter of fact they are worthy of all attention. It has been known for a long time that certain phenomena do occur amongst a certain class of persons which are, to say the least, inexplicable, for though it may be urged that collusion and connivance, conjuring and deceit, may be practiced occasionally, there is now a mass of trustworthy evidence demonstrating the truth of the hypothesis that thoughts are transferred from one person to another.

It must be conceded that until we can fully explain the mechanism of thought as found in any individual, that we have no right to say that it is impossible for one person to transfer his

[1] Proceedings of the Society for Psychical Research, Vol. I, Parts II and III. London, Trübner & Co.

thoughts to another; and to go further, we might say that until we can fully explain the phenomena of electricity we have no right to attempt to define the bounds of possibility in nature. Electricity has been known and utilized for years, but we are no nearer to a definite idea of what it really is than we were in the time of Volta and Galvani. There is ample material to enable us to form a good working hypothesis, and so also by a parity of reasoning there is quite sufficient to enable us to affirm that there is more in thought transference than those unacquainted with the phenomena have been willing to allow. In the second report of the committee on thought reading, or, more properly, thought transference, it is taken as established that "much of what is popularly known as 'thought reading' is in reality due to the interpretation by the so-called 'reader' of signs, consciously or unconsciously imparted by the touches, looks or gestures of those present, and that this is to be taken as the *prima facie* explanation whenever the thing thought of is not some visible or audible object, but some action or movement to be performed," and also that "there does exist a group of phenomena * * * which consist in the mental perception, by certain individuals at certain times, of a word or other object kept vividly before the mind of another person without any transmission of impression through the recognized channels of sense." The evidence the society is able to offer is fairly conclusive, and is certainly of such a character that it must be fairly met before its assumptions can be pooh-poohed in the orthodox manner.

Of the phenomena of dreams, chance coincidence, so-called apparitions, and what may be termed mental telephony, or telescopy, there is rather too much in the Proceedings, for there are so many authenticated cases that there is no reason to doubt that coincidences of the kind do occur; still, there is something weird in a case where a person saw others walking up the path towards the front door of her house at the very time they were drowned, and when we learn that the person actually ran to inform her friends that the others were coming up the garden, we can only conclude that there was some mistake, or that there was some actual transference of thought. The third report of the committee on thought transference contains the results of their experiments in a tabular form. Thus, with the trials to test the hypothesis of collusion, the actual results were one right guess in five and a quarter experiments (we give the totals only), while the chance of success by accident was only one in forty-three. In the series of experiments to test the hypothesis of chance coincidence, when the chances against success were fifty to one, upwards of forty per cent of the guesses were right, if the second and an occasional third response are admitted; but if the tests are confined to the first guess only the percentage is twenty-one, when, according to the laws of chance, the correct answers would

have been less than two per cent. The committee pertinently observe that their experiments derive much strength and coherence from their very multitude and variety; they have eliminated, as far as possible, the hypothesis of collusion, chance coincidence, and muscle or sign reading, and they are left with an accumulation of experiments which indicate clearly that thought transference is a possibility, or that there is some flaw in the evidence which they have been unable to discover. The third part of the Proceedings contains the first report of the committee on "mesmerism" and the first report of the Reichenbach committee, both of which will be found to contain a great deal more than is dreamt of in the philosophy of the ordinary world, though the committees respectively declare in the one case that they prefer to defer the publication of results, until a more complete reproduction of the experiments of others with added tests of their own have afforded a wider basis for discussion. The society has fairly established its demand for an inquiry by the scientific world, ever the most skeptical, and properly so, for it is the duty of science to reject everything that is not proven, while desirous, nay anxious, to take up any line of investigation that may lead to discoveries the ultimate result of which it cannot foresee.—*English Mechanic.*

ANTHROPOLOGY.[1]

THE PROTO-HELVETIANS.—The lowering of the levels of lakes Neuchatel and Bienne by the so-called "correction" of the Jura (a work undertaken for the prevention of floods) though it has by no means added to their beauty, is proving an immense gain to archæology. It has laid bare many Lacustrine stations, and rendered easy explorations which would otherwise have been impossible. Instead of the slow and often profitless process of dredging and picking up stray objects from between the piles at low water, the shrinkage of the lakes has permitted systematic excavations to be made in their former beds, on grounds which the Swiss antiquaries call the *couche archéologique.* The results are surprising beyond measure; besides throwing a flood of light on the history, the habits, and the civilization of the race of men who, thousands of years before the Christian era, made their homes on the lakes of Central Europe, and to whom has been given the apt name of Proto-Helvetians, they serve to correct old theories and suggest new conclusions. An idea of the richness of the finds made during the last ten years may be formed from the fact that the number of relics brought to light on lakes Bienne and Neuchatel since 1873, amounts to 19,599, of which 13,678 have been acquired by various Swiss museums. Nearly 6000 have been added to the collection of Dr. Goss, at Neuveville, on Lake Neuchatel, who has undertaken many explo-

[1] Edited by Prof. OTIS T. MASON, National Museum, Washington, D. C.

rations at his own cost, and in whose presence some of the most valuable discoveries have been made. He now owns the richest private collection of Lacustrine relics in existence, and at the request of many brother antiquaries, he has published thirty-three phototype plates, reproduced from photographs taken by himself, of his more important finds. The number of the objects depicted is nearly 1000, and being fac-similies of the originals, and half, and in some instances three-fifths, of the natural size, the illustrations, elucidated by the doctor's suggestive comments, are almost as interesting and instructive as a visit to the collection at Neuveville, according to Professor Morel, of Morges, a high authority, the most valuable, if not the largest, known to archæology.

Notwithstanding the doubts that have been expressed to the contrary, Dr. Goss holds to the theory of three ages, an age of stone, an age of bronze, and an age of iron, a theory to which every new discovery lends additional confirmation. There are Swiss lake dwellings where not a vestige of metal has been met with. There are others in which a few tools or arms of pure copper, and, exceptionally, of bronze are found. It is therefore a safe inference, as it is antecedently probable, that the use of copper preceded the use of bronze. In other stations, again, bronze preponderates and stone disappears. Last of all comes iron, first as a precious metal, ornamenting and encrusting the bronze which in the end it was destined to replace. A noteworthy fact is the comparative rareness of ruined villages of the age of bronze. On Lake Bienne there have been found the vestiges of thirteen villages of the stone age, and two only of the age of bronze; but the latter are far the more extensive.

The stone age is marked by three distinct periods. A first period, primitive and poor, characterized by the rudeness of its implements, the coarseness of its pottery, and an entire absence of stones of an exotic origin. Of this period the best type is the station of Charamus, near Neuveville, on lake Neuchatel. In the second period, the art of working in stone has reached almost perfection. Implements and weapons are well designed and deftly executed; exotic stones are abundant, the pottery is well made and richly ornamented. The types of this age are the stations of Locras and Latrigin, on Lake Bienne. The third period is characterized by the appearance of metals. It is a period of transition. There is still the same plenty of stone tools and arms, the general character of Lacustrine civilization remains unaltered, yet implements of copper, though few and far between, and rudely made, foreshadow an approaching change. This period is represented by the village of Fenil, on Lake Bienne, and the station of Roseaux, on Morgès near Leman. Next comes *le bel âge du bronze*, with its great development of art, to be followed, after the lapse of untold ages, by the age of iron, and

that mysterious conflagration in which perished a civilization as old as that of Egypt, and as interesting as that of Hellas.

There is a marked difference between the habitations as between the implements, of the age of stone and the age of metals. The former, if more numerous, are less extensive; they were but from fifty to one hundred yards from the shore; the piles which formed their foundations are short, and made generally of entire trunks of trees. Between the piles are found fragments of stag's horns, broken stones, pieces of rude pottery, and bones of animals. The stations of the age of bronze, on the contrary, were large villages, built at a distance of from 200 to 300 yards from the shore, on large, long, and often squared piles, between which are found remnants of fine pottery, and often entire vases. It is lower down, under the mud which has accumulated about the piles, that the great finds have been made. One of the most remarkable stations is the recently discovered village of Fenil. Although the exploration is not yet completed, more than thirty articles in pure copper have already been found, and as similar relics have lately come to light at Greng, on lake Thorat, at Peschiera, on Lake Garda, and in other places, antiquaries may ere long deem it expedient to add to the three recognized ages an age of copper.

The minute and systematic researches which have been made on the shores of Swiss lakes, albeit they have brought to light such a multitude of priceless relics, have not yet resulted in the discovery of a single Lacustrine habitation. A few charred planks and beams showing that they were destroyed by fire, are all that remain. Fortunately, however, we are not without light on the subject. A short time ago there was discovered in a marsh at Schussenried, in Wurtemburg, a well-preserved hut of the age of stone. The flooring and a part of the walls were intact, and, as appeared from a careful measurement, had formed, when complete, a rectangle, ten meters long and seven meters wide. The hut was divided into two compartments, communicating with each other by a foot-bridge, made of three girders. A single door looking toward the south, was a meter wide, and opened into a room 6.50 meters long and four meters wide. In one corner lay a heap of stones which had apparently formed the fireplace. This room was the kitchen, "the living room," and probably a night refuge for the cattle in cold weather. The second room, which had no opening outside, measured 6.50 meters long and five meters wide, and was no doubt used as the family bedchamber. The floors of both rooms were formed of sound logs, and the walls of split logs. This, be it remembered, was a hut of the stone age. It may be safely presumed that the dwellings of the bronze age were larger in size, and less primitive in their arrangements. At both periods the platform supporting the house communicated with the shore by means of a bridge (prob-

ably removable at pleasure) and with the water by ladders. These ladders, as appears from an example found at Chavannes, were made of a single stang with holes for the rungs, which protruded on either side.

The lake-dwellers, besides being carvers of stone, were workers in wood and skillful boat-builders. At Fenil and Chavannes have been found an ox yoke, fragments of tables, benches and doors, toy boats, hammers and spades, most of which Dr. Goss has presented to the museum of Berne. One of the best preserved canbes yet discovered was found in the stone age station of Vingrare (Lake Bienne) nearly three feet under the mud. The material is oak, the form of the stern square, like that of boats of the present day, the bow is pointed and spear-shaped. Its length is thirty-one feet two and a half inches, and in width it varies from twenty-nine and a half inches to thirty-five and a half inches. In order to prevent warping, the canoe was repeatedly washed with hot linseed oil, and afterwards rubbed with sand and wax, to fill up the interstices, by which means it has been kept in its original shape. With smaller objects of wood the same end is served by keeping them several weeks in alcohol or glycerine. Yew, however, is an exception; its durability exceeds that of oak; articles made from it show no signs of decay, and dry without warping.—[*To be continued.*]

The Antiquity of Man.—Professor Frederick W. Putnam, Curator of the Peabody Museum of American Archæology at Cambridge, made a few remarks at the semi-annual meeting of the American Antiquaries Society, bearing on the antiquity of man in America, based upon objects recently received at the museum.

He presented photographs of four blocks of tufa, each containing the imprint of a human foot. These blocks were cut from a bed of tufa sixteen feet from the surface, near the shore of Lake Managua, in Nicaragua, and were obtained by Dr. Earl Flint, who has been for several years investigating the archæology of Nicaragua for the museum, and has forwarded many important collections from the old burial mounds and shell heaps of that country. The volcanic materials above the foot-prints probably represent several distinct volcanic eruptions followed by deposits of silt. In one bed, apparently of clay and volcanic-ash, six and one-half feet above the foot-prints, many fossil leaves were found. Specimens of these are now in the museum, and their specific determination is awaited for with interest. While there can be no doubt of a great antiquity for these foot-prints, only a careful geological examination of the locality and a study of the fossils in the superimposed beds will determine whether that antiquity is to be counted by centuries or by geological time.

He also exhibited a portion of the right side of a human under-

jaw, which was found by Dr. C. C. Abbott in place in the gravel, fourteen feet from the surface, at the railroad cut near the station at Trenton, New Jersey. It will be remembered that in this same gravel deposit Dr. Abbott has found numerous rudely made implements of stone, and that in 1882 he found a human tooth, about twelve feet from the surface, not far from the spot where, as he states, the fragment of jaw was discovered on April 18, 1884. Both the tooth and piece of jaw are in the Peabody Museum, and they are much worn as if by attrition in the gravel. That they are as old as the gravel deposit itself there seems to be no doubt, whatever age geologists may assign to it, and they were apparently deposited under the same conditions as the mastodon tusk which was found several years since not far from where the human remains were discovered. While there is no doubt as to the human origin of the chipped stone implements which have been found in the Trenton gravel, a discovery to which archæology is indebted to Dr. Abbott, the fortunate finding of these fragments of the human skeleton add to the evidence which Dr. Abbott has obtained in relation to the existence of man previous to the formation of the great Trenton gravel deposit.

The discoveries announced in Professor Putnam's note are of the utmost importance, and they could not have fallen into more cautious hands. There is no doubt that Dr. Flint is an enthusiast on the antiquity of man in Central America. In a recent volume of the Smithsonian Annual Report, he is said to have found a cave that had been filled, after its formation, by tertiary sandstone. Now, on the removal of a portion of this sandstone, carvings, rock inscriptions were found on the walls of the cave, showing that man had arrived at the stage of rock carving in Central America before the deposits of tertiary sandstone. It is a pity that this cave cannot be visited by Professor Putnam.

Dr. Abbott's discovery, on the other hand, is simply in a line with his other finds. If man's works exist in the Trenton gravels, there is no improbability that man's remains will be found there. Wisely has Dr. Abbott yielded his own geological notions concerning his finds to the judgment of those who have studied systematically the Delaware basin.

Itinerant Anthropology.—A new event in the history of anthropology in our country is the decision of Professor Baird to participate in the great State fairs. and notably in the cotton exposition at New Orleans. A system of glass knock-down cases has been devised, so that the objects may be mounted in the museum and shipped safely. On arriving at their destination the cases can be set up by two or three workmen in a day or two. The recent appropriation of Congress for the New Orleans exhibit was so amended as to include Cincinnati and Louisville. The brief space allowed for preparation necessarily made the

number of cases at the two latter cities rather small, but the choice made was a good one. Three areas of aboriginal life were admirably portrayed, Alaska, Queen Charlotte islands, and New Mexico. In cases running parallel, Eskimo and Haida life were set one against the other, to bring before the eye the fact that in close proximities the tribes of men are powerfully influenced by their environment. The preparation for New Orleans will be on a much larger scale. Professor Otis T. Mason, who has recently been appointed curator of ethnology in the National Museum, will have charge of these migratory anthropological exhibitions and wishes to make them as educational as possible.

SECTION OF ANTHROPOLOGY AT TURIN.—At the Esposizione Generale Italiana in Torino, 1884, the section of anthropology was organized with much care and included a wide treatment of the subject. The following scheme will give some idea of the method of installation:

CLASS I.

Methods and Processes employed in the Anthropologic Sciences.

Category 1. Instruments and apparatus of anthropometry.
" 2. Instruments and apparatus of craniometry and pelvimetry.
" 3. Measures of muscular force, dynamometry.
" 4. Measures of vital capacity, spirometry, spirography, thoracometry.
" 5. Measures of sensibility, æsthesiometry.
" 6. Measures of experimental psychology, reaction, reflex action, &c.
" 7. Measures of temperature, pulse and respiration, thermometry, sphygmography, pneumography.
" 8. Methods of weighing the brain.
" 9. Processes of mounting and preserving crania and skeletons.
" 10. Methods of preserving brains and other soft parts.
" 11. Cranio-cerebral topography.
" 12. Chromatic tables for the hair, skin and iris.
" 13. Methods of obtaining indices and means.
" 14. Anthropologic instruction in Italy.
" 15. Catalogues, plans and documents of Italian museums, public and private.
" 16. Special exhibition of Societa d'Anthropologia, Etnologia e Psicologia comparata.

CLASS II.

Comparative and General Anthropology.

Category 1. Physical characters of the anthropomorphous apes.
" 2. Human and comparative embryogeny.
" 3. Physical characters of the races of man.
" 4. Rudimentary and atavic characteristics.

CLASS III.

Anatomical Anthropology.

Category 1. Collections of typical Italian skulls.
" 2. Collections of typical Italian skeletons.

Category 3. Collections of male and female Italian pelves.
" 4. Collections of typical Italian brains.
" 5. Preparations showing the development of the skeleton.
" 6. Anthropological models and casts.

CLASS IV.

Anthropo-biology and Ethnology.

Category 1. Normal development in height, weight, strength, vitality.
" 2. Puberty and menstruation among Italian women.
" 3. Refraction in the eye in relation with skull-form, schools, sex, &c.
" 4. Physiologic and anthropometric studies upon Italians.
" 5. Distribution of color in the hair and eyes of Italians.
" 6. Expression and physiognomy of the Italians.
" 7. Acclimation of Italians in foreign countries.
" 8. Acclimation of non-Italian peoples in Italy.
" 9. Anthropology of Sardinia.

CLASS V.

Pathological Anthropology.

Category 1. Anomalies in the development of the human body.
" 2. Cranial pathology.
" 3. The delinquent classes in Italy.
" 4. The insane in Italy.
" 5. The defective classes.

CLASS VI.

Prehistoric and Palæoethnic Anthropology.

Category 1. Geologic time. The Tertiary.
" 2. " " The Quaternary.
" 3. " " Recent period, palæolithic, neolithic and bronze.

CLASS VII.

Ethnography.

Category 1. Clothing characteristic of different parts of Italy.
" 2. Ornaments.
" 3. Accessories of dress.
" 4. Tattooing.
" 5. Habitations in model and design.
" 6. Characteristic furniture.
" 7. Pottery.
" 8. Textiles.
" 9. Primary industries (taking the gifts of nature).
" 10. Receptacles of every kind.
" 11. Land transportation.
" 12. Water transportation.
" 13. Religion, superstitions, legends *et similia.*
" 14. Feasts, fêtes, carnivals.
" 15. Music.
" 16. Popular dances.
" 17. Songs, books and prints relating to literature and popular superstition.
" 18. Italian ethnography.

Class VII, in our scheme, would be termed Technography.

MICROSCOPY.[1]

CALDWELL'S AUTOMATIC MICROTOME.[2]—This machine has been devised to save labor to the histologist by cutting a very great number of sections suitable for microscopic investigation in a very short time. The machine is worked by hand and may easily be made to deliver in one continuous band, accurately cut sections at the rate of 100 per minute. To use it, however, to the best advantage, it is well to drive it by means of some motor, the fly-wheel being already provided with a groove for the reception of the cord coming from the motor. Where there is sufficient pressure and supply of water, a simple form of water motor seems the most appropriate and least expensive.

Method of using the Microtome.—Place one of the cylindrical vessels supplied with the machine upon a piece of paper on a glass plate, and pour into it sufficient melted paraffine to fill it. As this cools the paraffine will contract, and will leave a hole, which must be filled up with more melted paraffine.

Melt a small quantity, say an ounce, of imbedding material in some suitable vessel; a small copper pan or a porcelain crucible answers very well, if care is taken not to allow it to become hotter than is sufficient to thoroughly melt it. Take a piece of glass and smear it with a very small quantity of glycerine, to prevent the imbedding material from sticking to it. Then pour the melted material on the glass in small quantities at a time, so as to get a layer nearly a quarter of an inch thick. This when cut up into suitable pieces with a knife does very well for imbedding small objects. If larger objects are required, it is well to have two pieces of brass of the form shewn in Fig. 5, which, when placed together, will form a cavity half an inch in depth and of any desired length up to an inch or more; this cavity may be filled with the melted material in the manner already described, and the object to be cut must then be placed in position while the material is fluid. *It is well to cool the material as rapidly as possible by placing it in water as soon as it is sufficiently set.* From the cake thus formed, or from the piece cast in the mold, cut the piece of the material containing the object, and with an old scalpel, heated in a Bunsen flame, melt a small hole in the paraffine contained in the cylindrical vessel (Fig. 1 *a*), and insert the piece of imbedding material containing the imbedded object; then with the heated scalpel melt a little of the paraffine round the base of the projecting piece, so as to give it firm support, and allow this to become thoroughly set.

Now remove the large brass plate from the top of the microtome (Fig. 1 *b*) and insert the vessel containing the imbedded object in the tube for its reception, having first oiled the tube

[1] Edited by Dr. C. O. WHITMAN, Mus. Comparative Zoology, Cambridge, Mass.
[2] *Quart. Jour. Micr. Sc.*, XXIV, Oct., 1884, p. 648.

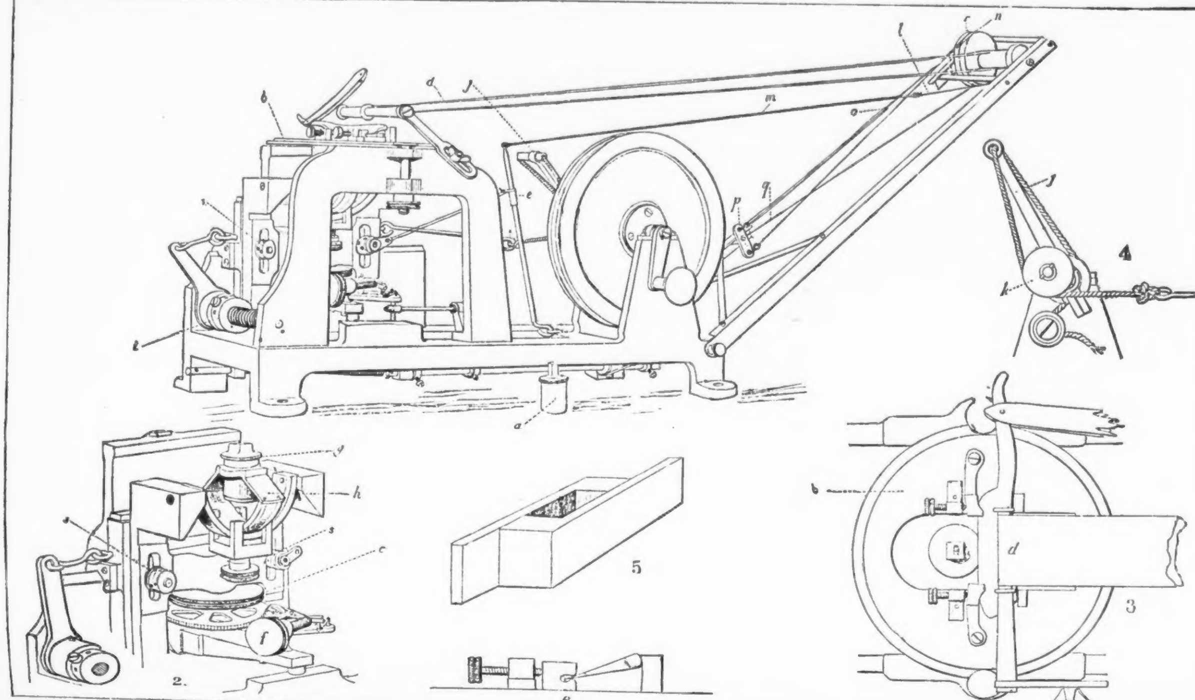
slightly to prevent the vessel from sticking. Next with a sharp knife *cut the material with the object imbedded in it, so that all its opposite sides are parallel.* This is extremely important. Replace the top plate and fix the razor in the holder provided for the purpose. The clamp is so made that if a little care is taken the edge of the razor will not be injured (Fig. 6). The razor must be set so that its back is as high as possible, as shewn in Fig. 6, and above all *the razor must be extremely sharp. It should be sharpened on a stone and not on a strop.* The sharpness of the razor and the accurate parallelism of the sides of the mass to be cut are the most important points in the whole process.[1] Underneath the frame containing the object is a large brass milled head (Fig. 2 *c*). By turning this the object may be raised or lowered according to the direction in which it is turned. This should be done until the object is just below the edge of the razor. The plate holding the razor should then be moved so that the edge of the razor is close to and quite parallel with the mass of material to be cut[2] (Fig. 3). The plate should then be clamped by the screws at each side of it. A few turns of the fly-wheel will now bring the razor in contact with the object to be cut. The band of black ribbon (Figs. 1 and 3 *d*) is now to be placed so that the end of it should be just above the razor and clamped in that position. When the handle is turned the sections should come off the razor in the form of a ribbon.

The ribbon of sections will not find its way to the continuous black band without assistance. With a needle in a handle or with the point of a scalpel pick up the end of the ribbon, when a sufficient length of it has been cut, and place it on the black continuous band, up which it will travel. When it reaches the top of the band suitable lengths may be cut off with a pair of scissors. It may be found that the black band travels either too slowly or too fast. Its speed may be varied by moving the ring (Fig. 1 *e*) up or down upon the vertical brass arm—upwards if it is moving too fast, downwards if too slow. A frequent cause of failure in the proper movement of the band is, that the ebonite roller at the bottom of it is allowed to press against the razor; this must be avoided.

[1] The makers of the instrument have nearly completed an automatic machine for sharpening razors, since it has occurred to them that this is an operation which may be performed with much greater accuracy by mechanical means than by hand.

[2] The distance through which the sliding stage moves can be altered by raising or lowering the arm (Figs. 1 and 4 *j*). This distance should be so arranged that the surface of the imbedding mass containing the object to be cut just clears the razor when the sliding carriage is at its maximum and minimum distance from either end of the machine. This is important as the speed with which the black band travels varies directly with the throw of the machine. If this adjustment is made and a little care is used in adjusting the ring (Fig. 1 *e*), see below, the ribbon will move at each turn of the fly-wheel through a distance equal to the breadth of the surface which is being cut. If, on the other hand, the object swings far beyond the razor, the band will travel too quickly and probably break the string of sections.

PLATE X.



Caldwell's Automatic Microtome.

Varying the thickness of the sections.—In Fig. 2 will be seen a milled head, *f*, which, when turned, controls the movement of the clicks which, acting upon the ratchet wheel attached to the micrometer screw, regulate the thickness of the sections. This may be done so as to allow the clicks to engage one-half, one or several teeth of the ratchet wheel as may be required. When arranged for one half tooth, the sections will be $\frac{1}{10000}$ of an inch (.0025^{mm}) in thickness, when arranged to engage a whole tooth $\frac{1}{5000}$ of an inch (.005^{mm}) and so on. At first it is well to use a whole tooth, as when thinner sections are cut so much depends on the sharpness of the razor. After cutting for some time the machine will suddenly stop, the object ceasing to rise when the handle is turned. This means that the full extent of the micrometer screw has been reached. It is necessary then to turn the large milled head (Fig. 2 *c*) downwards, which will allow the carriage containing the object to fall to its lowest limit. It will be necessary now to raise the socket (Fig. 2 *g*) in which the object is held so as to be in position to come in contact with the razor. This milled head (Fig. 2 *c*) is useful for rapidly getting the object in proper position and avoiding considerable loss of time in turning the handle. The frame (Fig. 2 *h*) which holds the socket is arranged with two quadrants, so that the socket may be set at any angle desired, and may be clamped with the milled head underneath it. This is for use when the object has not been symmetrically imbedded. The nut (Fig. 1 *i*) is for tightening up the spring which draws the carriage of the machine back after having been pulled forward. In case this does not work properly, it is only necessary to unloose the two screws and with some strong but blunt pieces of steel placed in the two holes, to rotate the nut so as to give a proper tension to the spiral spring. When this is done the screws should be tightened up again to keep the nut in place.

The lock nuts (Figs. 1 and 2 *s*) should be screwed up sufficiently tight to barely prevent the carriage from falling by its own weight, so that when the milled head (Fig. 2 *c*) is screwed down a slight pressure with the finger is necessary to make the carriage fall.

To arrange the machine for cutting different sized blocks of material, it is only necessary to raise or lower the arm (Figs. 1 and 4 *j*). When this arm is in a vertical position the machine is arranged for its maximum traverse. When turned to the right and placed horizontally it is at its minimum traverse. The cord, however, must always be in the groove of the wheel, *k*.

It is important to keep the strings which give motion to the endless band in proper position. The string (Fig. 1 *l*) should go from the end of the wire, *m*, round the groove, *n*, in the pulley and thence to the elastic band, *o*. The elastic band, *o*, should be stretched and placed over the hook attached to the arm, *p*, care

being taken that the shorter end of the arm, *p*, is uppermost. The string, *q*, should be tied to the stud upon which the arm, *p*, is supported, going thence round the groove, *r*, of the pulley, and back again to the hook at the longer and lower end of the arm, *p*, to which it should be tied.

Method of preparing the slide.—Make by the aid of heat a viscid solution of white shellac in light colored creosote. Spread a smooth, thin and even layer of this solution on a clean dry slide with a camel hair brush or with the little finger. Arrange the ribbon containing the sections on this slide while moist, and place it in the dry shelf of the water bath, which should be at a temperature slightly above the melting point of the imbedding material used. It should be left here until the creosote has evaporated and the imbedding material melted. Now allow the slide to cool, and then wash it with turpentine until all the imbedding material is dissolved. Canada balsam in chloroform or turpentine and the cover slip may now be applied in the usual manner. For convenience of mounting it is extremely important that the ribbon of sections should be quite straight, and in order to ensure this it is necessary that the sides of the imbedding material from which the sections are cut should be quite parallel. The straight ribbon, when obtained, should be removed to some clean surface and there cut into lengths appropriate to the size of the cover slips used. It will be found convenient to use cover slips at least two inches long; indeed, a useful length for slides and cover slips is six inches for the former and four inches for the latter.

A method of imbedding the specimen to be cut.—After the specimen has been stained it should be left in ninety per cent alcohol for a few minutes, and thence transferred to absolute alcohol, there to remain until all the water is extracted. The length of time necessary for this varies greatly with the size of the specimen. A three day chick, for instance, will require about an hour, larger specimens a day or more, in which case the absolute alcohol should be changed occasionally. Some tissues may be transferred directly from the absolute alcohol to turpentine, and thence in about two hours to the melted imbedding material. For delicate tissues, however, the following process, though longer and more troublesome, is greatly preferable. With a pipette introduce some chloroform to which two or three drops of ether have been added, under the alcohol in which the object is lying. The object will then float for some time at the junction of the alcohol and chloroform, and will finally sink into the chloroform when saturated with it. If, as often happens in the case of embryonic tissues, the object is lighter than the chloroform, it is not easy to tell when the saturation is complete, but generally on shaking the bottle a saturated tissue can be temporarily covered by the chlo-

roform, while tissues containing alcohol keep steadily on the surface.

When the tissue is saturated with the etherized cloroform it should be transferred to pure chloroform and there left for a few minutes. Then drop in some pellets of soft paraffine and leave it for two hours or more, shaking occasionally. The whole should then be poured into a small melting pot and a quantity of imbedding material added. The melting pot should then be placed in the water bath at a temperature of about 60° C., and there left until all the chloroform has evaporated, which may be determined by the absence of smell of chloroform on shaking. If much imbedding material is required this process takes a day or two; it is therefore better, when the solution of imbedding material is fairly strong, to take out the tissue and put it direct into pure melted imbedding material. In any case no chloroform must remain in the material to be cut, as it makes it brittle. Generally speaking the more gradually these processes are passed through the better will be the result.

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SCIENTIFIC NEWS.

— At a meeting of the Glasgow Philosophical Society in December, a paper was read by Professor W. Dittmar on the general results of his chemical work in connection with the Challenger expedition. Professor M'Kendrick commented on the paper, and said that the question of the breathing of marine animals was one of very great interest, and they could see at once that before it could be examined they must know something about the proportion of the gases dissolved in sea water. On that point they had been without accurate data up to the time of the very elaborate researches of which they had received an account that night. One fact which struck him as a physiologist as being most remarkable, was the very small quantity of oxygen in sea water, although it was yet sufficient for the respiration of fishes and other creatures living in the ocean. In point of fact blood was much richer in oxygen than sea water. It seemed to him that what they needed next was a careful analysis of the gases as they existed in the blood of fishes, more especially in that of some of those fishes which had been found at the depth of 2570 fathoms, living in a medium where the pressure on the square inch of the body must be something like three tons, because they had supposed that the problem of breathing depended to a considerable extent upon the law of pressures. It was well known that life could be maintained with a small quantity of oxygen in the event of carbonic acid being removed, and it was probable that in the case of those fishes, while the percentage of oxygen

was small, the carbonic acid would at once be taken up, so that it did not accumulate in the immediate vicinity of the breathing apparatus.—*English Mechanic.*

— In an address delivered lately at Preston, after distributing the prizes to the students of the Harris Institute, Professor Tyndall spoke of the three great discoveries which in after time will be regarded as the glory of the present age, vis: those of the conservation of energy, the principle of evolution, and the germ theory of disease. The germ theory of disease in its earliest glimmerings appeared centuries ago; but William Budd was the first to see further than his contemporaries, and his grand generalization has been confirmed by experiment. So long ago as 1817 Schwann demonstrated that putrifaction was the work of living organisms, and in 1863, Pasteur followed with his far more elaborate researches. A high tribute was paid to Koch's researches. The immunity enjoyed by the vaccinated, Tyndall accounts for on the supposition that contagia being living things, demand certain elements of life, and when those are exhausted they can no longer live. To exhaust a soil, then, a parasite less vigorous and destructive than its virulent representative may suffice, and once the soil is exhausted the virulent type is powerless to injure. Such in substance is the germ theory of disease.

— At the Newport meeting of the National Academy of Sciences, Mr. Fairman Rogers referred to Mr. Muybridge's experiments made last summer on the motions of animals by instantaneous photography. No especially new system is used, but the apparatus has been perfected in many details, and dry plates are used, so that superior results may be looked for. While many instantaneous photographs of animals in motion existed before those made by Muybridge, they were mere isolated attitudes of motion, giving very little information, while his, being consecutive, and taken at equal intervals of space or time, give all the information regarding the different phases of the motion. It is perfectly possible to apply this method to the study of all kinds of motion, and it must come into use for that purpose. It would be useful, for instance, to study in this way the propelling action of the tails of fishes, with a view of determining the proper form for screw propellers, which will not only give good results in economic propulsion, but will avoid the vibrations accompanying high speed.

— Professor Bickmore, of the American Museum of Natural History, will give a course of ten lectures for the benefit of such teachers in the public schools as are required to deliver object lessons upon botany and zoölogy. The first six lectures will be devoted to human physiology and anatomy. The lectures are all to be illustrated by stereoscopic views, and in order to make them

as widely useful as possible, a copy of each one, together with a set of the stereoscopic slides which were used for its illustration, will be sent to each normal school in the State. The series, which begins on October 18, is the commencement of a course of lectures which is to extend over four years, and be conducted in the same way and for the same object. The Legislature has appropriated $18,000 to defray the expenses of these lectures.

— A tidal wave burst into the harbor of New Haven, Conn., at 11 o'clock, Dec. 22. It is now believed that there must have been a convulsion of the earth in Long Island sound, directly off the harbor, or near by, for at quarter past eleven a tidal wave, crowned with foam and fully eight feet high, came rolling into the bay from the south, traversing the entire length of the harbor, which is four miles long. It had a speed of about twelve miles an hour, and moved with an ominous rushing sound, like the blast of a hurricane, carrying destruction in its path.

— The second Abtheilung, *Arthropoda*, of the Zoologischer Jahresbericht for 1883, was issued in November. It has been prepared by Drs. Paul Mayer and W. Giesbrecht, assisted by a corps of specialists. It is a most indispensable work to the zoölogist; and this part is very full in abstracts of and reference to the entomological literature of 1883. It is a product of the zoölogical station at Naples.

— The Johns Hopkins University circulars for December contain abstracts of essays on the following topics: On a new law of variation, by W. K. Brooks; Method of formation of the trochosphere in Serpula, by W. H. Conn; The gill in Neptunea, by H. L. Osborn; On the presence of an intracellular digestion in Salpa; On the structure and affinities of Phytoptus, by J. P. McMurrich.

— By the death of Robert Alfred Cloyne Godwin-Austen, F.R.S., geology loses one of its most distinguished students. Mr. Godwin-Austen was born in 1808, and died on Nov. 25th, at his residence near Guildford. He was associated with the late Edward Forbes in work on marine zoölogy, and edited and continued Forbes' Natural History of the European seas.

— The professors of the Philadelphia Academy of Natural Sciences have organized themselves as a faculty and elected Professor D. G. Brinton dean, and Professor Angelo Heilprin, secretary.

— At a December meeting of the London Western Microscopical Club Mr. F. Cheshire showed some beautiful specimens of bacilli which produce disease among bees.

— The deaths are announced of two renowned physiologists, viz: Professor von Vierordt, of Tübingen, and Professor von Wittich, of Königsberg.

— Dr. Thomas Wright, F.R.S., of Cheltenham, in whom geology and palæontology lose a distinguished student, died in December last.

— Professor D. S. Jordan has been appointed president of the University of Indiana, at Bloomington.

— Erratum: on p. 109, line 15, for *bogs* read *bays*.

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PROCEEDINGS OF SCIENTIFIC SOCIETIES.

Philadelphia Academy of Natural Sciences, May 29.—Mr. Ford announced the discovery of *Pholas truncata* in peat near Sea Isle city. Mr. Redfield said that he had found this species thirty years ago, closely packed in salt-water turf, near Rye, Long Island sound, and he believed the species might be found in similar locations all along the coast.

June 12.—Professor H. C. Lewis gave the results of his examination of dust from Krakatoa, taken from the rigging of the bark *William H. Besse*. By far the greater part is powdered glass, but crystals of transparent plagioclase, and irregular fragments of pyroxenic materials, probably augite and hypersthene, as well as grains of magnetite, occur. The dust does not at all resemble that described by Mr. Wharton, and collected in Philadelphia. The same speaker described a curious round, rock-like exposure of basalt at Blue Rock, Chester county, Pa.

June 19.—Professor Heilprin spoke of the great difference between the Foraminifera of the rotten limestone of Northeastern Mississippi and that of the ooze of the Gulf of Mexico. He also showed an example of *Calymene niagarensis*, taken from the Eocene above Vicksburg, but evidently washed down from the Silurian. Dr. McCook called attention to certain globular nodules of earth which were the cocoons of a tube-weaving spider of the genus Micaria. Spider cocoons, covered with scraped bark, old wood, etc., had been found before, but this was the first occasion in which a covering of mud had been found. The specimens were gathered upon fallen boards by Mr. F. M. Webster, assistant State entomologist of Illinois.

July 10.—Professor Heilprin showed the tail-piece of a trilobite found at the Delaware Water Gap. He proposed to name the species *Phacops broadheadii*. It is near *P. nasutus*. Its hori-

zon is the Stormville shales of the Lower Helderberg. Miss G. Lewis described a schizomycete found in a sulphur spring at Clifton Springs, N. Y. Mr. Meehan stated his belief that the fasciation of a branch was a premature attempt to form flowers.

July 17.—Professor Heilprin reported the discovery, in the Stormville shales, at the Delaware Water Gap, of the tooth of a Cestracion. Mr. Meehan exhibited specimens of the Western annual sunflower (*Helianthus lenticularis*), and spoke of the probability that it was the parent of the garden sunflower. A paper on the geology of Delaware was presented for publication by Professor F. D. Chester.

American Society for Psychical Research, Dec. 18.—To this meeting were invited all those who had accepted the invitation to join a psychical society, sent out by the committee of organization appointed by the meeting held in Boston, Sept. 23d. This committee consisted of G. Stanley Hall, E. C. Pickering, H. P. Bowditch, C. S. Minot, William Watson, S. H. Scudder, William James, Alpheus Hyatt, and N. D. C. Hodges. The meeting was called to order by Professor E. C. Pickering. Mr. S. H. Scudder was chosen chairman *pro tem.*, and Mr. N. D. C. Hodges secretary *pro tem.* Mr. Scudder told the history of the movement which had resulted in the formation of the society, giving in some detail an account of the work done by the committee, which had had full charge of the work of organization. The first business was the election of fifteen members of the council of twenty-one, which will have charge of the conduct of the society. G. Stanley Hall, George S. Fullerton, William James and E. C. Pickering, were elected for three years; Simon Newcourt, C. S. Minot, H. P. Bowditch and N. D. C. Hodges, for two years; and George F. Barker, S. H. Scudder, Rev. C. C. Everett, Moorfield Storey, Esq., John Trowbridge, William Watson and Alpheus Hyatt, for one year. The constitution provides that seven shall be elected each year, to hold office for three years.

The committee on work made an informal report, and has since issued a circular calling for volunteers to go on the investigation committees, and for information in regard to furnishing subjects for investigation. The society then adjourned to meet January 8th.

Biological Society of Washington, Dec. 13.—The following communications were made: Mr. Leonhard Stejneger on an exhibition of specimens illustrating the shedding of the bill in auks; Mr. George Vasey on the grasses of the arid plains; Mr. Charles D. Walcott, on the oldest known fauna on the American continent; Professor Lester F. Ward on the occurrence of the seventeen-year locust in Virginia in October, 1884. Additions to the Flora of Washington, made during 1884.

Dec. 27.—Mr. Frederick W. True on a new porpoise, *Phocæna dalli*, from Alaska; Mr. John A. Ryder on the development of the rays of fishes; Mr. John Murdoch on a collection of marine invertebrates obtained by Lieut. A. W. Greely, U. S. A.; Mr. G. Brown Goode on natural history at the New Orleans exhibition.

New York Academy of Sciences, Nov. 24.—The following paper was announced for the meeting: The glacial and pre-glacial drifts of Staten Island and New Jersey, by Dr. N. L. Britton; Mr. George F. Kunz exhibited and made brief remarks upon some gems and gem-minerals.

Dec. 15.—The food-plants and fiber-plants of the North American Indians (illustrated), by Professor J. S. Newberry.

American Geographical Society, Dec. 12.—Lieutenant Frederick Schwatka, U. S. Army, delivered a lecture, entitled Alaska, and exploration along the Yukon river. An account of the longest raft-journey in the world, illustrated with stereopticon views.

Appalachian Mountain Club, Boston, Dec. 9.—Lieutenant Frederick Schwatka, U. S. A., read a paper on Alaska and the British Northwestern Territory.

Dec. 18.—After the routine business of the evening, those present were given the opportunity to enjoy an hour of social intercourse. A series of lantern views representing mountain scenery on the Pacific slope, presented to the club by Mrs. E. A. Lane, was also exhibited. Photographs now in the possession of the club were on exhibition, and members were invited to bring any photographs they may have of mountain scenery.

Boston Society of Natural History, Dec. 17.—Dr. G. L. Goodale spoke of the continuity of protoplasm in certain vegetable tissues.

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